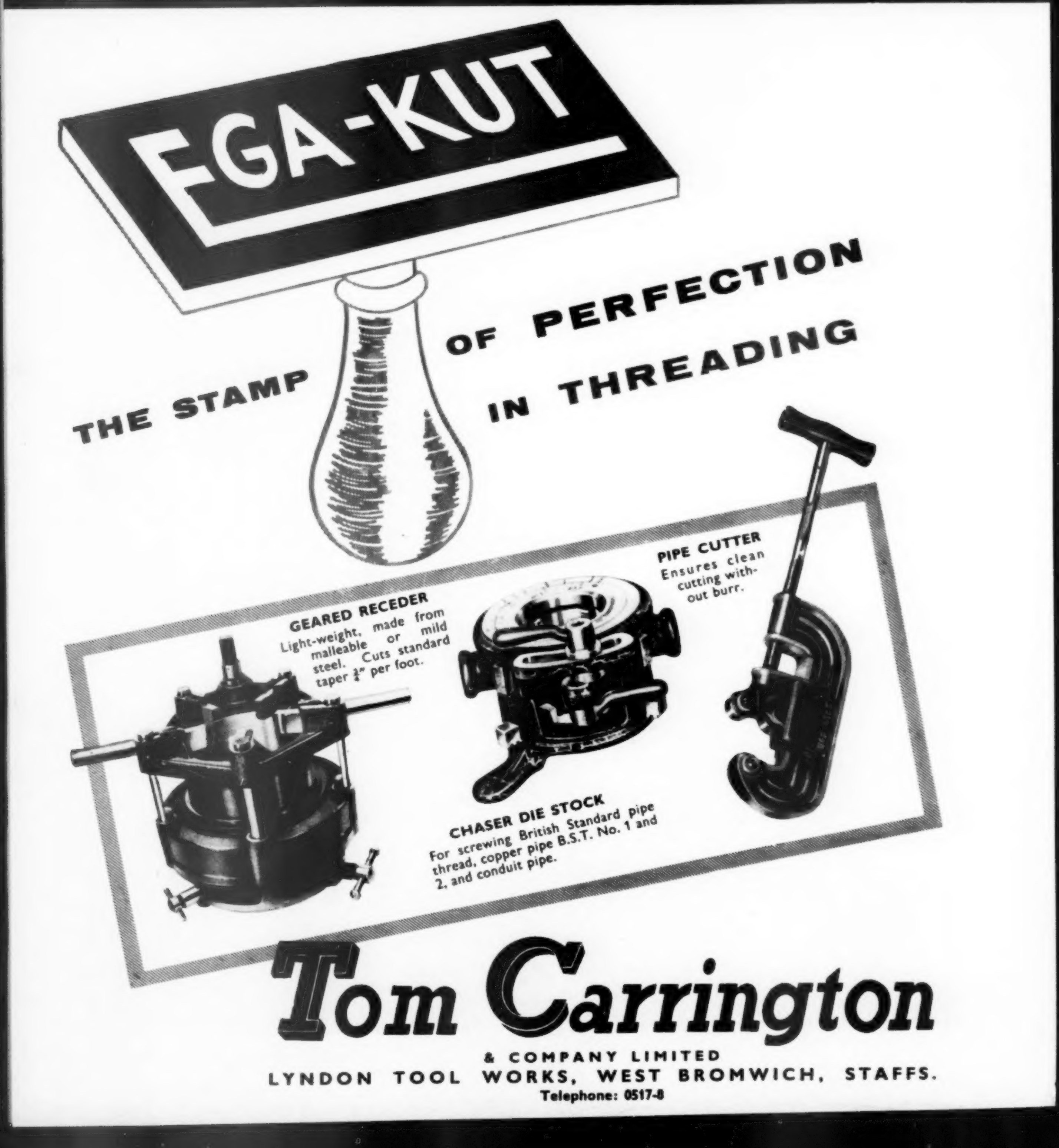

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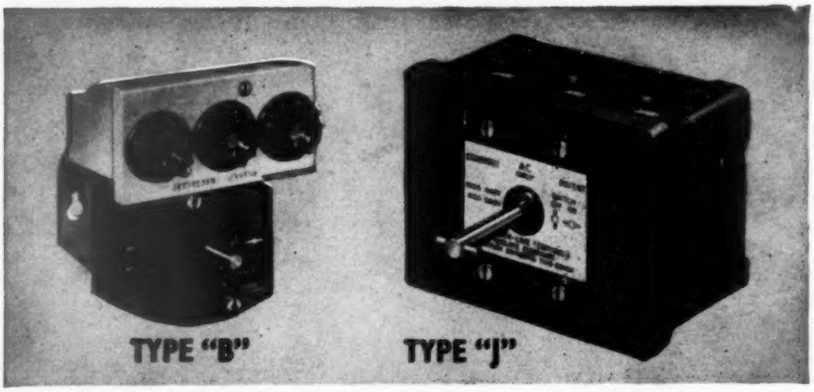

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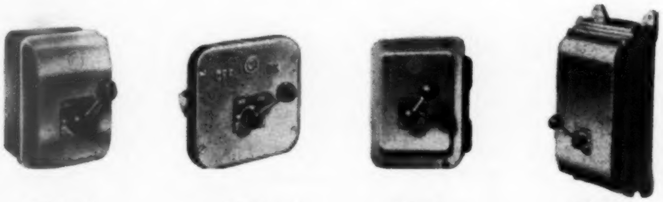

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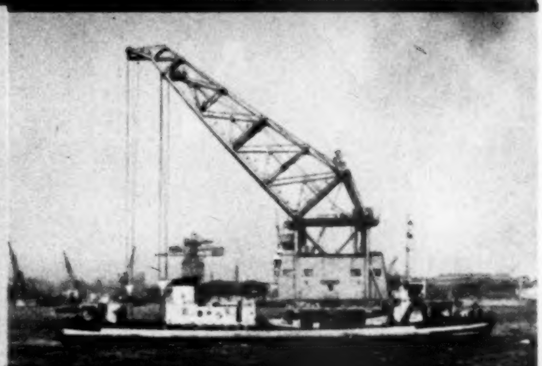

60 tons load capacity

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* —Derrick: the word originates in the name of an early 17th century hangman and would suggest more the lowering of dead-weights !

Illustration shows typical bearings used on the floating "Samson" crane including the large double row ball - thrust bearing.

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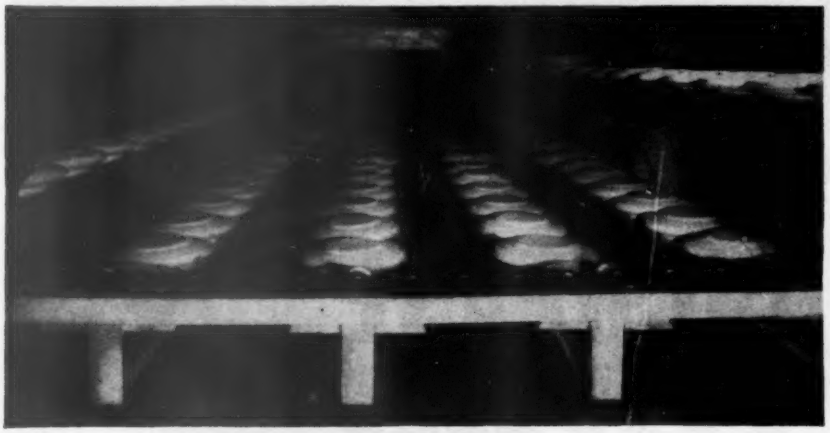

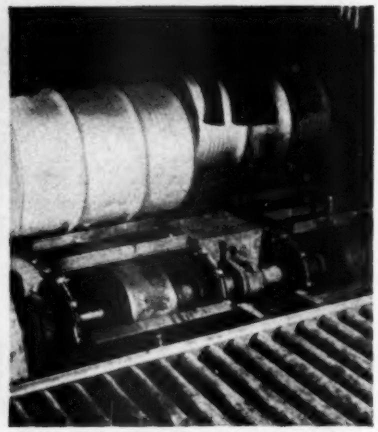

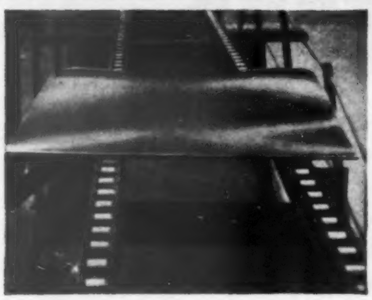

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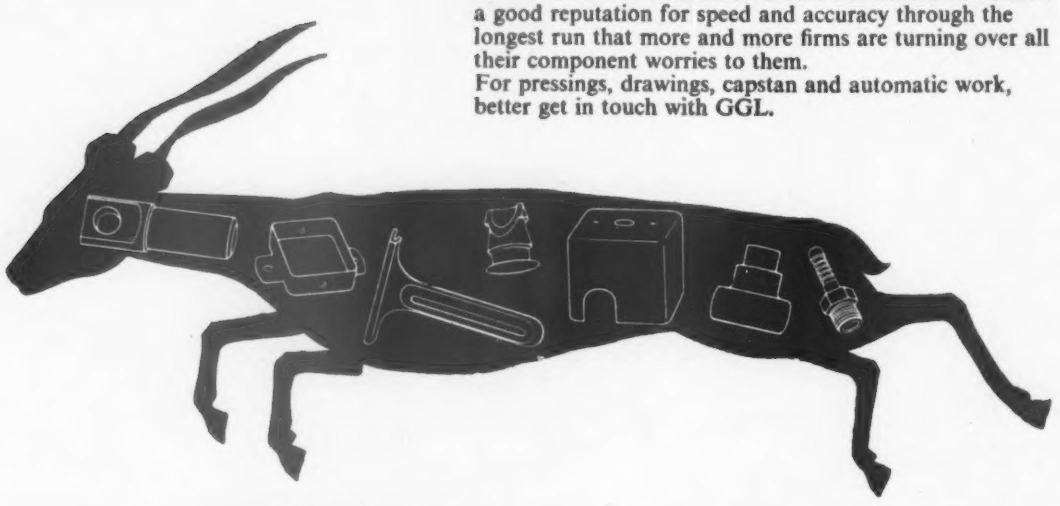

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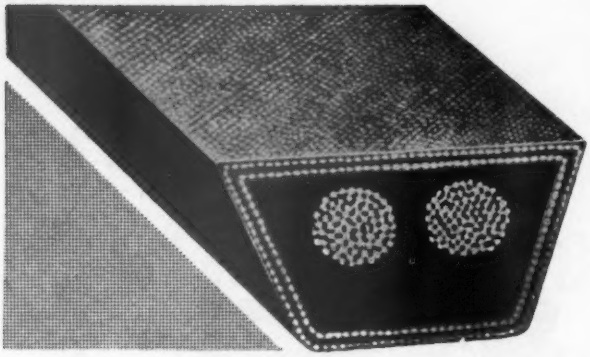

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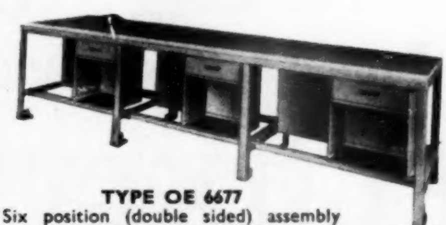

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Mechanical World

AND ENGINEERING RECORD

Vol. 142 | JULY, 1962 | Number 3516

Contents

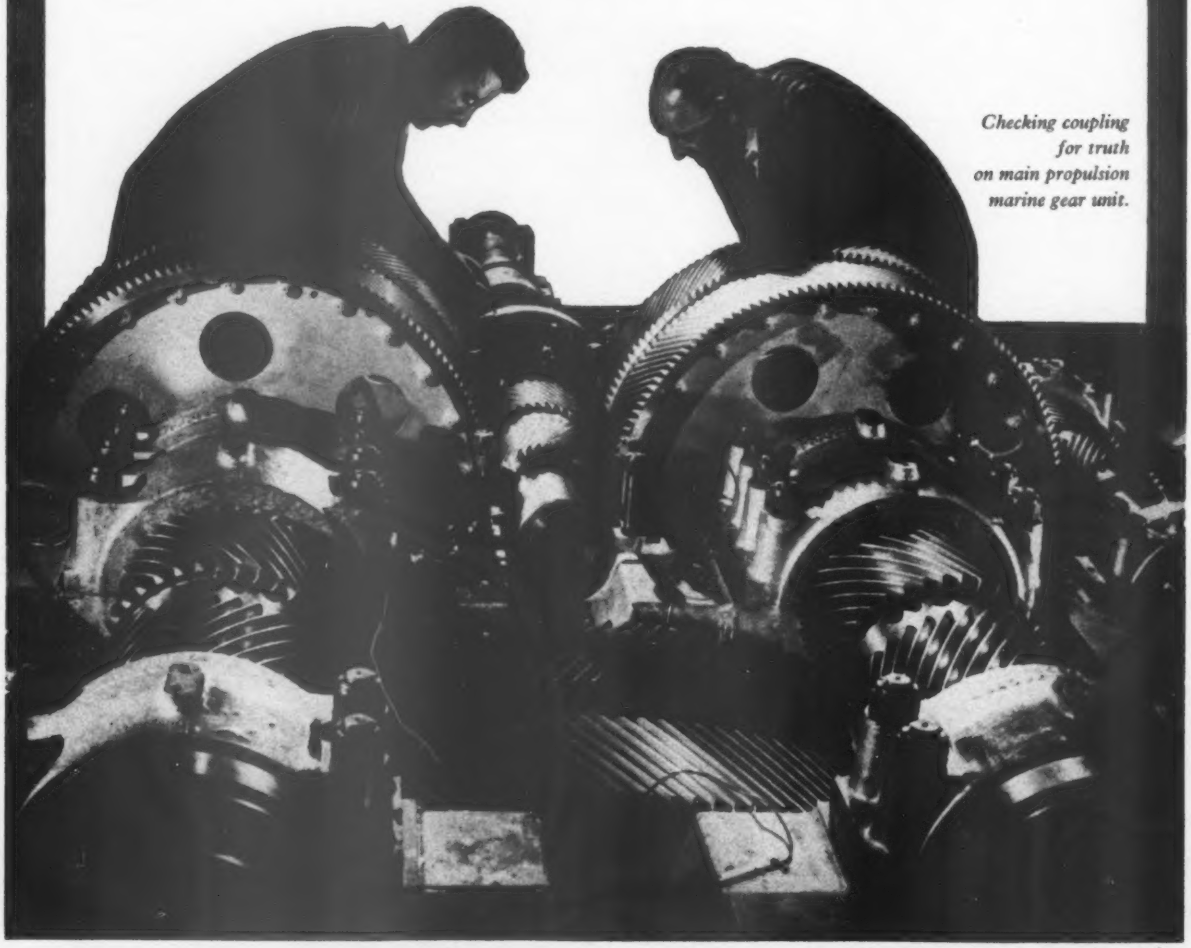
MECHANICAL WORLD AND ENGINEERING RECORD is published monthly in Manchester and London.
MANCHESTER: 31 King Street West, 3.
Telephone: BLAckfriars 7086.
Telegrams: Textile, Manchester.
LONDON: 158 Temple Chambers, Temple Avenue, EC4.
Telephone: FLEet Street, 8914.

Subscriptions. The annual subscription rate throughout the world is 30/- post free. Subscription orders may be sent to the publishers at either of the addresses given above, or placed through any newsagent or subscription agency. The price of single copies is 2/6 (3/3 by post).

Advertising. Communications and inquiries should be addressed to the Advertisement Manager at the Manchester address given above.

Remittances should be made payable to the publishers, Emmott & Co. Limited, and crossed "Midland Bank Limited".

Contributions. The Editor invites original contributions on mechanical subjects. Broadly the aspects covered are the design, materials, manufacture, process, management and maintenance of engineering and industrial plant and machinery. Sketches may be in pencil. Photographs are welcome and so are short notes of practical experience. Payment is made for exclusive contributions. Communications should be addressed: The Editor, MECHANICAL WORLD, 31 King Street West, Manchester 3.



Checking coupling for truth on main propulsion marine gear unit.

Power to Hand

THE industrialized countries depend very much upon electric power for their prosperity, and it is certain that the developing countries, in their turn, will need a great expansion of electricity generation to bring their economies up to a satisfactory level, and this irrespective of the form taken by their industrialization. Just how much electricity they will need is a matter for speculation. There must be limits, different as between one place and another according to circumstances, but at present the limits are indeterminate. The scale of electricity generation today in different parts of the world shows great variation. In illustration of this Sir William McFadzean presented some tabular data in the course of his Presidential Address to the Fourteenth British Electrical Power Convention. This showed that in the United States with a population of 177.7M the installed generating capacity is 174 MkW, and in Canada with a population of 17.4M the capacity is 18.6 MkW. These figures represent approximately 1 kW per head of the population. The installed capacity per head diminishes as we read down the table from 35 MkW for 52.2M people in the United Kingdom to 8.1 MkW for 260.3M in Africa and 17.6 MkW in China and countries other than those in the table, for 1186.9M people.

The total generating capacity for the whole world is given as not less than 460 MkW, and the world population as 2795M. If the standard everywhere were the same as North America the world would require 2795 MkW instead of its present 460 MkW—more than six times as much. This is an upper limit, but it is only the upper limit at the present state of development and it may not be so far from reality at some time in the future, for the present larger users might well double their supply in the next ten years, which will go a long way to offset lower usage in countries where the industrial pattern might never require so much, though their rate of power installation in the immediate future could well be much greater.

This can be seen already in the big projects under way or being considered in many parts of the world—in Africa, Australia, Canada, South America—in all of which British consultants have played a leading part, based upon a reputation going back in some places for over sixty years.

The power sources to be tapped are many of them familiar—hydro-electric, fossil fuel, oil—but not all these will be used in every area where power will be needed. New sources are being explored—the fuel cell, the Seebeck effect, thermionics, magnetohydrodynamics and geothermics for example—and some of these will certainly fit in with certain circumstances and climates where power will be needed. There is, of course, the ultimate to which to look forward. Nuclear fusion perhaps, when generation might take on a character and magnitude hardly as yet imaginable. In that event maximal transmission will be essential; but it will be no problem for this is a science which keeps well ahead of application.

LOG SHEET

Century of Precision

Societe Genevoise d'Instruments de Physique, Geneva, specialists in precision jig boring machines and measuring equipment celebrated its centenary in June.

Since its foundation in 1862 Societe Genevoise d'Instruments de Physique has many outstanding achievements to its credit, including the solidification of hydrogen by Pitet in 1870 and the re-dividing of thirteen of the prototype metre standard scales for national standards laboratories throughout the world. The most recent development has been the manufacture of a photo-electric comparator of the highest precision necessary for the inter-comparison of the prototype metre scales with the new international wave length standard at the International Bureau of Weights and Measures in Paris.

Since 1923 the distribution of the Swiss company's products to Britain and the Commonwealth has been handled by Societe Genevoise Limited. During the war years when the supply of new machines from Switzerland was cut off and the need for them in war production was at its height, an organization was established to service and re-build worn and bomb damaged machines. Subsequently a separate company was formed under the name Sogenique (Service) Limited and from its factory at Newport Pagnell this company has since considerably extended its activities. It is now responsible for the installation and servicing of jig boring machines and measuring equipment in Great Britain, Scandinavia and the Benelux countries; moreover it is the only part of the group where re-building is undertaken.

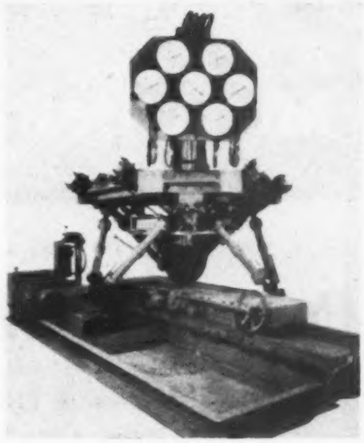
The activities of the British Group have been increased by the acquisition last year of Reilly Engineering Limited, since re-named Servomatic Hydraulics (Guildford) Limited, a company which manufactures high speed hydraulic grinding spindles and electronic tachometers. The electronic measuring system developed by Reilly Engineering Limited is now produced by a new company Sogenique (Electronics) Limited at Newport Pagnell and by the parent company in Geneva.

Remote Welding

A special argon-arc type fully automatic welding head for the rapid and reliable joining of tubes in confined spaces has been developed at the Erith Works of G.E.C. (Engineering) Limited. It is for use in the installation of the many miles of stainless-steel gas-sampling tubes forming part of the burst-cartridge detection system at the Hunterston Nuclear Generating Station. Where access is severely restricted inspection may be difficult and the welding process must be completely reliable.

Essentially the head consists of two tungsten electrodes $\frac{1}{16}$ in. dia having a life expectancy between repointings of not less than 20 welds. They are mounted opposite each other on a rotating head in a frame provided with two split clamps for attachment above and below the joint. A motor on the frame drives the head forward through 180° in a plane parallel to the tube, and then reverses to return the head to starting position. Argon is fed to the head through a length of plastics tubing and arranged to flow around each electrode.

Welding is done in two runs, the first to pre-heat the assembly in preparation for the second welding run. One weld takes 40 sec to complete.



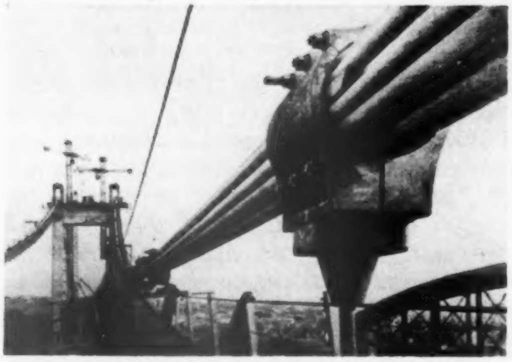
TYRE DESIGN "COMPUTER".—The new Dunlop universal tyre test machine in which the tyre is mounted at the foot of a turret which is supported by six jacks, each of which can be separately controlled. Load-measuring devices are mounted in the turret to measure directly the forces in six directions. The base plate against which the tyre is loaded can be moved backwards and forewards or be rotated and the tyre itself can be tilted at any angle so that steering, rolling and all tyre motions can be simulated

CRANE WORKS MODERNIZES.—The first stages of a modernization plan for the Reddish Stockport factory of Heywood Cranes Limited has been completed. A new stores building, reception bay and stores office have been built and accommodation for drawing office staff more than doubled. Machine shop capacity has been increased by 40% and erecting shops by 60%. Picture shows part of a contract for ten cranes for Richard Thomas & Baldwins Limited

Million Volt Portable Test Set

The testing of high voltage cables, after installation, in various remote or relatively inaccessible parts of the world may often present particular problems or require the availability of special equipment, and British Insulated Callender's Construction Company Limited have recently designed and manufactured a fully portable set capable of carrying out tests in the neighbourhood of a million volts. It has been used for testing the 330 kV oil-filled cables made by BICC for the Snowy Mountains Hydro Electric Authority at Tumut 2 underground power station, New South Wales.

The base of the set, which has to support the high voltage unit which



SUSPENSION BRIDGE CABLE BAND.—A close-up of one of the cast steel cable bands with suspension rope socket on the Tamar Bridge. Bands and other steel castings totalling 165 ton were made by W. Shaw & Co. Limited, Middlesbrough

A photographic study from the book "Wards at Work 1962". The machine is a Rigiva universal milling machine fitted with vertical head.

is 15 ft high and weighs 1½ ton, is an aluminium honeycomb sandwiched between aluminium sheets bonded together with epoxy resin. The high voltage unit comprises a three stage voltage doubler giving 300,000 volt per stage fed by a 120,000 volt transformer, the whole system being remotely controlled by a small portable console unit. All metering of the transformer primary voltage and current and the d.c. output voltage and current is displayed on the console unit. In addition, the automatic earthing boom attached to the high voltage transformer is also remote-controlled from the console. The equipment is fully interlocked and overload protected to ensure the safety of the operators.

Satellite Communication

Almost all the equipment at Goonhilly used by British Post Office and the United States National Aeronautics and Space Administration (N.A.S.A.) in experiments to assess the technical feasibility of long distance communication by artificial earth satellites is of British design and construction, and the whole project, from obtaining the site to the final installation and testing of the equipment, has been carried out in less than a year.

Two experimental satellites to be launched into orbit by N.A.S.A. during 1962 will be of the active type containing radio receivers and transmitters to enable signals received at the satellite from one ground station to be amplified before re-transmission to a second ground station.

The Goonhilly station is equipped with a large, steerable dish aerial, some 85 ft dia. Orbital information obtained by telegraph from N.A.S.A./Goddard Space Flight Control Centre in the U.S.A. is processed in an electronic computer at Goonhilly into a form for steering the aerial.

Signals received are very weak and a Maser located in a cabin at the back of the dish is used to amplify them. High-power 5 to 10 kW microwave transmitters are in a cabin on the aerial turntable.

Equipment is provided for generating both still and moving pictures using British, European and American line standards, and for simulating up to 600 telephone circuits.

Halden Reactor Second Stage

The boiling heavy water reactor of the O.E.C.D. Halden Reactor Project has been successfully started on its second fuel charge of enriched uranium oxide. This will enable operating powers of 20,000 kW to be achieved, or some four times the power previously obtained with the first fuel charge of natural uranium. The reactor is an undertaking of the O.E.C.D's European Nuclear Energy Agency and is an experimental process steam producer used for basic studies of operational and technological problems associated with the development of boiling reactors. Operation with the first charge began in June, 1959 and was completed in April 1961, power levels up to 6000 kW being achieved. Since then the reactor has been shut down for extensive modification to permit operation at the higher powers.

Photographic Record

The accompanying photograph is from a new book, "Wards at Work 1962", prepared by Thos. W. Ward Limited, Albion Works, Sheffield, which provides a pictorial survey of recent activities of the Ward Group of Companies. There are some 150 photographic studies, all without exception of excellent composition and equally satisfactory in the way detail or significant impression is conveyed. In fact the book is a considerable work of first-rate photographic art.

The pictures are grouped according to the various departments and constituent companies and convey very clearly the quality and great variety of products and services offered by the Group.

Instrument Technology

There have been great advances in the technologies of measurement and control in the last decade and to take account of this and foster further development the Society of Instrument Technology has decided to replace its previous two Control and Data Processing Sections by four sections to deal with Measurement Technology, Control Technology, Systems Engineering, and Automation. In future all grades of members will be members of each section without registration so that they will be kept in touch with these activities.

Modern Lubricating Oils

The number of possible additives for lubricating oils runs into hundreds, each one of which is capable of performing a useful duty or enhancing certain characteristics of the basic oil. In many cases an improvement in performance is obtained at the expense of another desirable characteristic—detergents, for example, have a side effect of decreasing the resistance of the oil to oxidation. Detergent additives, therefore, are usually compounded with an oxidation inhibitor. Many additives are of a multi-purpose type. In other cases compatibility with other additives present, or with operating conditions, must be closely studied. The main additive types and their purposes are discussed in this article

MODERN oils are compounded with a number of additives designed to modify the physical characteristics of the oil in a desired direction or enhance certain performance features. All such additives perform a useful function, that is, of improving the performance or "tailoring" the oil to meet specific service conditions. Only one additive commonly used has no functional purpose, that being the dye employed to give a definite and consistent colour to oils and fluids, yet this is equally valuable from a psychological point of view to yield what is traditionally accepted as the correct appearance of a good lubricant for general service. It also serves to mask colour differences that might otherwise occur between different batches of a particular oil of the same grade and make, derived from different crude oil sources but identical in properties. The use of colouring in the old days was strictly necessary to hide the marked change in appearance which could occur even in storage from oxidation of unrefined materials left in the oil. It has persisted as standard practice—and many people still judge oil by colour—but about the only useful purpose it can perform today is to disguise the amount and type of additives incorporated, the presence of which might be recognized by their particular colouring effect.

Viscosity, together with colour and oiliness are the general features by which the practical engineer still tends to evaluate lubricating oils although none, except viscosity, is of any real significance. The true working properties of the modern lubricating fluids are more largely concerned with the number and proportion of additives incorporated which are hidden features and only likely to become apparent in service.

Viscosity, on the other hand, is still the main parameter for assessing grade and is significant in determining the correct fluid (grade) for providing adequate lubrication at a specific working temperature, or over a range of working temperatures. It is usually necessary, for example, to ensure that in service the viscosity does not fall below a certain minimum figure, otherwise lack of lubrication may result, or excessive slippage in a hydraulic pump with resulting high power loss and a further rise in fluid temperature. Thus the oil grade must be chosen with due regard to its viscosity at maximum service temperature.

At the other end of the service temperature the viscosity must not be so high at minimum temperatures that the fluid is sluggish with high friction and poor flow properties, even to the extent of channelling. Under such condition power loss will again be high and lubrication poor. Provided the viscosity characteristics of the fluid meet these two extreme demands, however, viscosity itself will have little further significance other than in governing the hydrodynamic drag at typical service temperatures.

Fluid viscosity is temperature dependent, decreasing with increasing temperature and increasing with decreasing temperature. Viscosity-temperature characteristics are commonly related to viscosity index which is a comparative parameter and an arbitrary measure of performance rather than a specific characteristic. A high viscosity index implies a small change in viscosity with temperature, and vice versa, but the specific change can only be plotted in the form of an empirical curve. It is highly dangerous, for example, to estimate "end viscosities" merely on the strength of a quoted viscosity index figure.

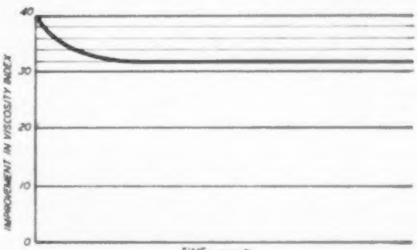


Fig. 1 (left).—Typical effect of shear on performance of V.I. improver

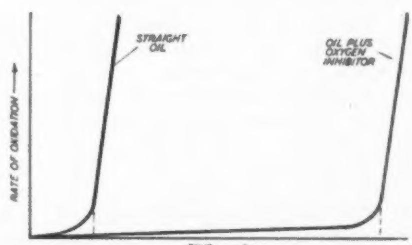


Fig. 2 (right)—Characteristic extension of induction period with oxidation inhibitor

When originally established as a scale, a viscosity index of 100 was allocated to a typical high grade paraffinic oil and zero to a typical naphthenic oil. All other known oils at the time then had intermediate values. Broadly speaking, oils with a high proportion of paraffinic hydrocarbons tend to have relatively high viscosity indices, and those with a high proportion of naphthenic hydrocarbons low viscosity indices. With the greater range of crude oils now available, and improved methods of refining, viscosity indices from below 0 to above 100 can be produced—e.g., typically up to about 115 at the high end. Modern automobile engine lubricating oils normally range in the 90s, with hydraulic oils somewhat higher, although both types may be com-

pounded with additives to improve the viscosity index.

The main significance of this is that an oil with a high viscosity index is obviously desirable where working temperatures may be subject to a considerable range—e.g., from cold starting to final running temperature in the case of internal combustion engine lubricants, or from extremes of low temperature at altitude to tropic ambient temperatures in the case of aircraft hydraulic fluids, and so on. In such cases an oil of high viscosity index ensures a more constant performance throughout the range. For general industrial applications the viscosity index of the oil is usually less important as it is worked at a more or less constant ambient and under constant service conditions.

The demand for higher viscosity indices is, therefore, largely confined to automotive engine lubricants and hydraulic fluids. In the former case it is a definite advantage to use a low viscosity oil for starting from cold. With a high viscosity index the same low viscosity oil may then retain sufficient viscosity at the higher working temperatures to remain fully effective as lubricants. Compounding with additives, or viscosity index improvers as they are specifically known, enables the viscosity index of a typical blend to be raised to the order of 140 to 150. At this figure an oil can duplicate the viscosity characteristics of a W-viscosity oil at 0° F and those of a higher viscosity number oil at 210° F. In other words such an oil may have the same viscosity as a "straight" SAE 10W oil at 0° F, and that of a "straight" SAE 30 oil at 210° F. Over that same temperature range the "straight" SAE 30 oil may show a change in viscosity from around 60 (at 210° F) to considerably more than the 12,000 Saybolt seconds specified as the maximum for SAE 10W.

These high viscosity index lubricants are commonly referred to as "constant-viscosity" or "multigrade", the latter being the more technically correct since the viscosity is not in actual fact rendered independent of temperature by the addition of viscosity index improvers. The general effect of the additive is to raise slightly the viscosity at low and medium temperatures—e.g. over the range 0° to 100° F, but show a substantial increase in normal (unblended) viscosity at 210°F. This results in a "multigrade" performance since it can be equivalent to covering the requirements of an SAE-W oil and an oil rated at 210° F one or two steps higher in number (usually the latter). Thus typical gradings for oils with viscosity index improvers are 5W/20, 10W/30 and 20W/40—see Table I for reference of SAE classifications.

Typical additives employed to improve the viscosity index are long chain molecules of polymerization products of methacrylate esters, styrene-olefins, etc. which, because of their large molecule size, have an inherently high viscosity. At low temperatures, however, these molecules remain in suspension in the basic oil and thus have only a small effect on the overall viscosity. With increasing temperature more and more of the additive enters into true solution, markedly increasing the overall viscosity at a particular temperature, relative to that of the basic oil itself at that temperature. This change is reversible as the temperature is decreased, with the additive reverting to a suspension.

One basic limitation of viscosity index improvers is that they are subject to breakdown under shearing, and also to some extent by thermal cycling and high service temperatures, resulting in a loss of viscosity index during service. As regards shearing effects the loss will depend upon the magnitude of the shearing forces, these being highest in regions of small clearances, such as in bearings, between piston rings and bore, at the tips of vane pumps, etc. In general, shearing effects will bring about an initial loss, after which there will be little, if any, further reduction in viscosity index—see Fig. 1. The extent of this initial loss and the period over which it takes place will depend both on the magnitude of the shearing forces and the rate of shear.

Thermal degradation, however, tends to be more progressive. Thus under continual use at high service temperatures (e.g., an internal combustion engine lubricant) a continual and gradual loss of viscosity index can be anticipated. These breakdown products can contribute to the formation of sludge and varnish deposits and it is common, therefore, to increase the proportion of detergent additive to take care of this. A higher proportion of detergent additive will often be called for in any case since viscosity index improvers tend to have the effect of decreasing the efficiency of detergent additives.

Detergents and oxidation inhibitors are closely related, although both types of additives perform different functions. The primary, and original, function of a detergent additive is to retain products of oxidation or degradation in suspension rather than allowing them to settle out in the form of sludge deposits or varnish. Oxidation inhibitors, basically, are simply additives with a preferential and high affinity for oxygen so that the normal oxidation process is restricted to degradation of the additive rather than the basic oil, until eventually all the inhibitor is used up. After that oxidation of the oil will take place.

Mineral oils, which consist basically of complex mixtures of hydrocarbons, contain a number of compounds with a certain affinity for oxygen. The rate of oxidation depends upon the types of hydrocarbons present, and the conditions under which reaction can take place, particularly the degree of exposure to air and the presence of any substances with a catalytic action. Where oil is agitated, mixing with air, the possibilities of oxidation are considerably increased. A high operating temperature is also conducive to rapid oxidation, whilst the presence of finely divided metal particles (such as wear products) will accelerate oxidation

Table I—SAE OIL CLASSIFICATION

S.A.E.	Permitted Viscosity Range (S.U.S.) Minimum	Maximum	At
5W	—	4000	0°F
10W	6000	less than 12,000	0°F
20W	12,000	—	0°F
20	45	less than 58	210°F
30	58	less than 70	210°F
40	70	less than 85	210°F
50	85	110	210°F

Table II.—PRINCIPAL ADDITIVES

Additive	Purpose	Side Effects	Remarks
Viscosity Index Improvers	Raise viscosity Index	Subject to shear breakdown	
Detergents	Prevent agglomeration of sludge. Resist acidic corrosion.	Tend to promote oxidation. Tend to increase possibility of foaming.	Usually compounded with an oxidation inhibitor.
Oxidation inhibitors	Delay oxidation.	Good anti-wear and anti-scuffing properties.	Enhance oil life.
Anti-corrosion	Passivation or deactivation of metal surfaces.	—	Characteristics given by multi-purpose oxidation inhibitor.
Anti-wear	Improved film strength.	May be chemically active.	—

by catalytic action. Copper, iron and lead particles are particularly active catalysts, in this latter respect.

Upon oxidation, hydrocarbons may form insoluble carbonaceous compounds or oil-soluble degradation products such as resins and acids. The rate of reaction, and the type of degradation product, will depend upon the types of hydrocarbons involved. Paraffinic hydrocarbons, for example, tend to react less readily with air than the aromatic or unsaturated hydrocarbons. Since both types may be involved in the oil blend both soluble and insoluble oxidation products may result.

The insoluble products form sludge and can clog oil lines and passageways, filters and other parts of the system. The soluble products, on the other hand, will continue to circulate with the oil. Resins will then have a tendency to deposit themselves on the hottest parts of the system, forming varnish-like coatings. The soluble acids may show corrosive effects, corroding and pitting bearings (particularly copper-lead alloy bearings) and generally attacking all metal surfaces.

When blended with an effective oxidation inhibitor the oil will show an extended period of life during which virtually no oxidation (of the oil) occurs (see Fig. 2). Oxidation, as such, is characterized by an "induction period" during which the rate of oxidation is low, followed by relatively rapid oxidation. The inhibitor considerably extends the induction period because of its greater affinity for oxygen and its capacity to react directly with any oxidized oil molecules, until eventually it is all used up. Oxidation of the basic oil then proceeds normally.

Detergents, as previously noted, are effective in combating the undesirable effects of sludge and similar insoluble products by preventing them agglomerating and retaining them in suspension where their size remains comparatively harmless. Being mainly soaps their alkalinity also helps neutralize soluble acid products of oil degradation. This is a particularly useful feature of an automotive type lubricant where the by-products of fuel combustion may also be acidic, and also contribute to sludge formation under certain operating conditions.

Table III,—ADDITIVES FOR LUBRICATING OILS

Type	Additive	Normal Concentration	Remarks
Detergent	Metallic soaps, etc.	—	Particularly effective in engine oils.
Dispersants	Sulphonate or phenate complexes of alkali metals.	—	Combined detergent—dispersant action.
V.I. improvers	Polymerized methylacrylate esters, buetene or styrene olefins.	4–8%	Particularly effective in engine oils and hydraulic oils.
Oxidation—inhibitors	Amine and phenol derivitives	up to 5%	—
	Sulphur and phosphorous compounds	up to 5%	Improve film strength.
	Zinc dithiophosphate.	up to 5%	Multipurpose type with anti-corrosive and anti-wear properties.
Film strength improvers	Zinc dithiophosphate	0·75–1%	For normal anti-wear requirements.
	Active chlorine	up to 6%	For mild E.P. lubricants
	Active sulphur or sulphur-chlorine.	up to 8%	High duty E.P. lubricants.
	Sulphur-chlorine-phosphorous.	up to 10%	Hypoid oils.
Corrosion inhibitors	Usually feature of detergent and/or oxidation inhibitor.	—	—
Rust inhibitor	Chosen with regard to service conditions and compatibility with other additives used.	—	Typical use in hydraulic oils, and lubricants for steam turbines, etc.
Anti-foam agent	Silicone fluid.	1 part in 1,000,000	Used where service conditions may promote foaming (e.g. automatic transmissions, hydraulic systems, etc.)
Oiliness additive	Fatty acid esters, e.g. butyl stearate.	—	Not generally used. or widely applicable.
Tackiness additives	Rubber solutions Cut-back bitumens Heavy polymers.	—	To provide "non-drip" properties.
Pour point depressants	Polymerized phenols and esters.	0·1–1%	To improve very low temperature flow properties.

Modern detergent additives, therefore, tend to have a high degree of alkalinity and are also compounded as dispersants as well as detergents. That is to say their property of retaining the insolubles in suspension in unagglomerated form is enhanced. Similarly, modern oxidation inhibitors may also be effective in protecting metal surfaces against corrosive attack either by passivating the metal surface (e.g., by incorporating reactive sulphur in the additive); or deactivating it after attack (when the additive reacts with the corrosion product to form an inactive compound resistant to further attack.)

Whilst viscosity index improvers, detergents and dispersants, and oxidation and corrosion inhibitors are the main types, numerous other additives may be used to enhance specific properties, or to combat undesirable effects generated under certain service conditions or applications. The more common of these are probably the compounds used to improve film strength where boundary lubrication conditions are encountered, or generally to improve anti-wear properties. Boundary lubrication conditions occur when the load is so high that the oil film tends to be squeezed out from between the surfaces it is protecting and lubricating so that actual metal-to-metal contact may occur between high points on the two surfaces. This gives rise to points of high friction and extremely high localized temperatures —so high, in fact, that local welding or "seizing" can occur.

Additives aimed at combating these conditions are of a type which will combine chemically with the mating surfaces at regions of high localized heat, yielding a surface compound with a low shear strength. Thus a continued sliding motion is maintained rather than local welding followed immediately by the tearing apart of the metal surfaces. Lubricating oils so compounded are generally referred to as "extreme pressure" (E.P.) type, or "hypoid" oils. Actually any lubricant which has an additive which effectively increases the film strength is an "E.P." lubricant, although a distinction is usually drawn between those intended for less severe applications (E.P.) and those for extremes of pressure ("hypoid" oils). The main difference between the two is that the E.P. oils contain lower amounts of less active additives.

Typical additives in the E.P. class are active sulphur and active chlorine. Active sulphur and active chlorine together are more effective than chlorine additive alone. A chlorine type additive may be used in the milder E.P. lubricants and either a sulphur or sulphur-chlorine additive for higher pressures. Hypoid oils normally use sulphur-chlorine-phosphorous type additives in relatively high proportions. One point which must be considered with all extreme pressure lubricants is the possible active chemical effect of the additives at the working temperature concerned and service conditions.

Normal anti-wear additives are of a much milder nature and, in fact, may not be a separate additive at all. The usual oxidation inhibitor—zinc dithiophosphate—itself has a marked effect in improving the film strength of the lubricant and so its presence will normally ensure better wearing and scuffing properties.

Considerations in the Design of a Copper Scrap Refining Furnace

Introducing a new technique involving metallurgy and heat transfer with steam raising

By F. MOLYNEUX, Ph.D., B.Sc.(Lond.), B.Sc.(Eng.), A.M.I.Mech.E., A.M.I.Chem.E.,
Senior Lecturer, Department of Chemical Engineering, Birkenhead College of Technology

IT seems strange that in view of the price and importance of copper as the most used non-ferrous metal there have not been the intensive developments in improved methods of fire refining to parallel those in the iron and steel industry. Possibly the reason for this may be found in the present-day practice of refining the ore on the site and transporting the refined metal in its most expensive form for least bulk. This applies in particular to the large centres in Central Africa where this phenomenon is accompanied by cheap and ample labour and also comparatively cheap power, and this has certainly been the factor leading to the practical elimination of ore refining in the U.K.

These factors, however, do not apply to the refining of copper from scrap, and since it is considered that 40% of the total copper used in the U.K. arises from this source, it can be seen that there might be a considerable incentive towards cheaper and more efficient methods of production. Since little improvement can easily be foreseen in the methods of electrolytic refining, it was considered that major benefits might be sought in the methods of fire refining scrap.

Fire refining methods currently in use can generally be classified under three main headings, largely depending on the origin of the scrap to be refined. These are:

(1) low copper content scrap, such as rich copper slag, dross, spillage and skimmings produced by foundries, and by-product mud from chemical separations

(2) medium-to-high copper content alloys from the user industries, such as car radiators, old loco fire-boxes and brass and bronze parts salvaged from process plant and machinery, and

(3) pure unalloyed copper scrap, such as wire, turnings, stampings, sheet punching, etc., from fabricators' shops.

In the case of scrap arising from Class (3), any refining operation would be unnecessary and would lead to losses, and, in general, the larger fabricator usually instals his own remelting furnace for the recovery of this material and finds that this is well worthwhile, since the equipment is simple and inexpensive. Refining of scrap copper is mainly concerned with Classes (1) and (2), and in both cases difficulty arises initially in determining the composition of the furnace charge, since even with careful sorting it is difficult to determine the exact metal content so that the correct proportion of flux may be added to give a controlled charge. The general recommendation, however, is that scrap of Class (1) be smelted in the copper blast furnace, and that of Class (2) in the copper converter. The raw copper from both blast furnace and converter is then refined in an anode furnace to give a tough pitch copper suitable for finishing by electrolytic refining if required.

It can thus be seen that for the fire refining of a low-copper scrap at least three types of furnace are required to carry out in essence the same process, which is that of converting impurities into oxides which will form fusible slags separable from the melted copper. Thus, it is uneconomic for the small refiner to consider treatment if scrap arises from all sources, and generally it is found that concentration is on (1), (2) or (3), with corresponding equipment.

Development of new technique

It was considered that with modern developments in refractories, metals and fabrication, and with the spread of industrial technology, there was scope for the development of a single simple furnace for the small refiner capable of dealing with scrap from all sources. This would be of the rotary type, consisting of a cylindrical steel shell about 15 ft long and 6 ft dia, lined with rammed mullite refractory and capable of being rotated about its horizontal or longer axis.

Charging and pouring would take place via a refractory manhole in the cylindrical shell of minimum dimensions for the expected charge. A schematic diagram of the proposed plant is shown in Fig. 1.

The furnace is heated by a burner at one end operated on gas, oil or pulverized coal, the waste gases being exhausted at the other end via a refractory-lined flue and a waste heat boiler, finally passing to atmosphere by way of a high efficiency cyclone for flue dust recovery.

Oxidizing air or tonnage oxygen is fed into the molten charge by means of external pipes connected to fused alumina nozzles (Fig. 2). This oxidizing injection is made by means of a stationary valve plate on the burner, free of the furnace, and operates over the lower third of the furnace periphery only. The remaining two-thirds of the periphery is provided with a mixture of carbon monoxide and nitrogen from a producer.

Operation

A preliminary analysis is made of the scrap charge and the correct addition of silver sand, limestone and iron pyrites made to give an easily fusible slag of low density. The furnace having been heated to 2,000° F (1,100° C), the scrap and flux are charged and the furnace is rotated slowly with air blowing through the lower ports, so that a thorough mixing of the charge and the oxidizing air and a better utilization of the heat stored in the lining are thereby affected.

After melting, the charge is blown for half an hour to oxidize the iron, which is then slagged off as a silicate, possibly in accordance with the following equation:

$$FeS + 3\,Fe_2O_3 + 7\,SiO_2 = 7\,FeSiO_3 + SO_2.$$

Various non-ferrous metals, such as lead, zinc and tin, are simultaneously converted to oxides and slagged off. Thus: $PbO + SiO_2 = PbSiO_3$.

Lead oxide in particular is notoriously vicious in its attack on the refractory lining if thorough mixing and slagging do not take place.

The following reactions take place during the conversion:

$$2\,FeS + 3\,O_2 = 2\,FeO + 2\,SO_2$$
$$2\,Cu_2S + 3\,O_2 = 2\,Cu_2O + 2\,SO_2$$
$$Cu_2O + FeS = Cu_2S + FeO$$

Care should be taken by means of the appropriate controls to prevent oxidation of the copper, since losses in the slag will otherwise be high as a result of the production of a rich 30% copper slag which must be returned for refining.

The aim at this stage is to produce a lean slag with the following approximate composition:

SiO_2	FeO	CaO, MgO, Al_2O_3	Cu	PbO, ZnO, SnO
35%	45%	18%	1%	Remainder

This is an easily fusible slag with a specific gravity of 3·25, which can easily be poured and separated from the molten copper. The compositions of typical slags are set out below:

	SiO_2	FeO	CaO	Al_2O_3	Cu
Slag 1	32·5	52·2	4·8	7·2	0·39
Slag 2	34·0	46·0	11·0	5·0	0·69
Slag 3	44·5	39·7	9·9	6·2	0·21
Slag 4	39·3	24·8	25·2	6·2	0·3
Slag 5	42·2	39·4	7·0	4·0	0·29
Slag 6	42·0	22·0	26·0	4·0	0·23

The best treatment for the slag is to run it through a fore-hearth settler and then to granulate it by placing a fan-shaped spray of water beneath the slag spout of the fore-hearth with a trough or launder carrying a flow of water beneath the spray. As the hot slag falls through the spray into the launder, it granulates and is thus easily swept away.

Large amounts of zinc, lead and tin are vaporized at this stage of the process and are carried out of the furnace by the waste gases. The lead and tin are deposited in the base of the waste heat boiler and are recovered from there, whilst the zinc oxide is cooled in the waste heat boiler to be removed finally from the exhaust gas in the cyclone.

A further oxidation blow now takes place to slag off remaining impurities together with a proportion of the copper. The slag from this operation is rich, containing up to 35% copper, and must be granulated and recharged to the furnace. The remaining copper is approximately 97% pure, impurities being tin, lead, zinc and nickel, and to this hot charge is added any high-grade copper scrap. Air or oxygen is introduced, which oxidizes the impurities and forms a slag, and owing to the lower purity of the copper —97% as against a normal 99%— a much greater slag fall takes place.

Oxidation is continued until a sample shows saturation with oxygen, when the air supply is stopped, together with rotation of the furnace, and a charge of the correct quantity of charcoal made to the furnace. Rotation is then continued, the metal being de-oxidized with the thoroughly mixed-in charcoal in an atmosphere

Fig. 2.—Slip cast pure alumina nozzle for air injection

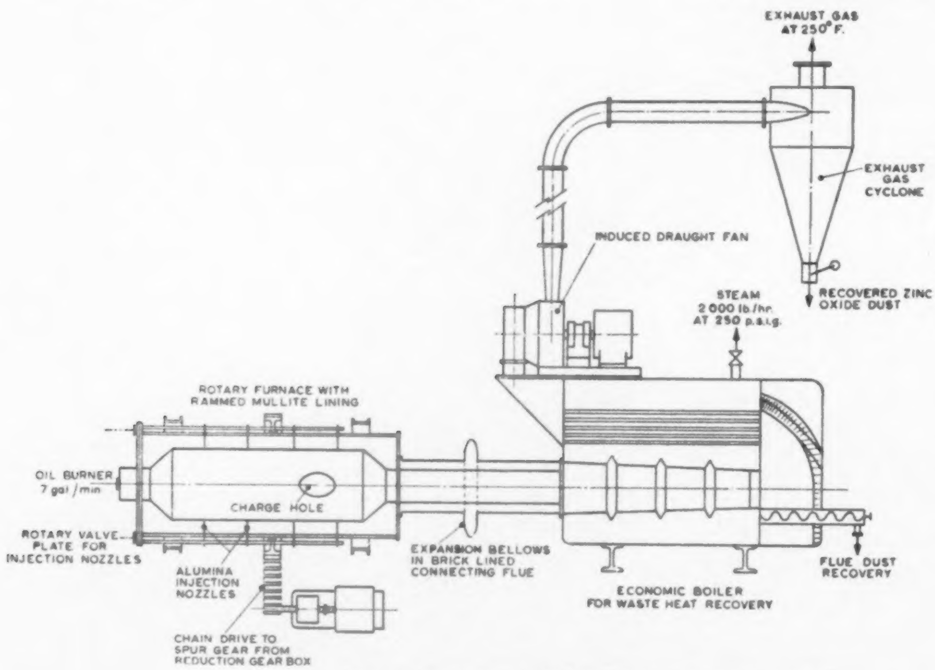


Fig. 1.—Schematic diagram of the proposed copper scrap refining plant

of carbon monoxide and nitrogen, the final product being a tough pitch copper of over 99·9% purity.

Process design calculations

The following calculations are necessary in order to arrive at some idea of the size of units required for the operation of this process on a plant scale. The stages to be considered in these calculations are as follows:

1. Total mass and volume of the furnace charge

In addition to the quantity of scrap copper to be charged, this requires a determination of the weight of fluxing agents to be added. To do this a short ton (2,000 lb) of copper scrap of the given composition is taken as a basis and the fluxes required for this amount then calculated. These quantities are then multiplied by the factor involved in the actual charge of copper scrap required for processing.

2. Furnace design

This involves determination of the dimensions of the furnace so that the solid charge can be heated up to fluxing temperature, the flux removed as molten slag, and the oxidized copper then reduced in the molten state prior to pouring either into ingot moulds or into a copper shot producing plant.

3. Fuel requirements

The quantity of oil fuel required must provide:

(a) heat to melt the charge
(b) heat to flux impurities
(c) heat to keep the flux, slag and charge molten
(d) heat to recoup that lost through radiation, convection and conduction and
(e) heat to raise the temperature of the furnace brickwork, etc., from cold.

4. Surface required in waste heat boiler

A considerable amount of heat will normally be exhausted in the waste gases which are at a high temperature, but in this case a waste heat boiler is to be provided to improve the efficiency by recovering a portion of this otherwise wasted heat. The surface required in the boiler to recover this estimated quantity of heat must be calculated and provided in a commercial boiler.

These are the stages listed and worked through in the following calculations giving the basis for the final estimates of the dimensions of the various plant items.

Stage I—Total mass of charge

The following calculations are based on a charge of 2000 lb of scrap of the composition given below. The composition of the melt and the slag are also stated.

Scrap composition

Cu%	Fe%	Zn%	Pb%	Sn%	Al%
40	30	20	5	3	2

Clean slag composition

SiO_2%	FeO%	$(CaO+Al_2O_3)$%	Cu%	SnO%	PbO%	ZnO%
35	45	16	1	0·8	1·2	1

Melt composition

Cu%	$(Sn + Pb + Zn)$%
97	3

Materials used for fluxing purposes include silica sand, iron pyrites and limestone. The first of these contains 80% SiO_2 and 15% FeO; the second 40% Fe, 10% CaO and 10% SiO_2; and the limestone, 50% CaO (including Al_2O_3 and MgO) and 3% SiO_2.

In general, with relatively high copper contents in the scrap charge, the slag will amount to 50-100% of the weight of the scrap charged. In this particular case it is governed by the weight necessary to take all the iron (as oxide) into the slag. The iron content of the 2000 lb scrap charge is 600 lb, equivalent to 770 lb FeO. With a slag weight of 1000 lb (50% of the scrap charge weight), the FeO content would amount to no more than 450 lb —much below the FeO produced by oxidizing the iron in the charge. With 2,000 lb of slag the iron content would be 900 lb and the SiO_2 content 700 lb. The scrap charge considered here can be fluxed without the addition of pyrites, and if we disregard the small amount of SiO_2 in the limestone and assume it all comes from the silica sand, the weight of the latter charged is:

$$(700 \times 100)/80 = 875 \text{ lb}$$

This would introduce FeO to the extent of

$$15\% \text{ of } 875 \text{ lb} = 130 \text{ lb}$$

Thus the 900 lb FeO in the slag is made up of 770 lb from the oxidized charge and 130 lb from the silica sand.

The weight of $CaO + Al_2O_3 + MgO$ in the 2000 lb of slag is:

$$16\% \text{ of } 2000 \text{ lb} = 320 \text{ lb}$$

With limestone containing 50% CaO, etc., this calls for the charging of 640 lb of limestone.

Thus, the charge sheet for 2000 lb of scrap reads:

Scrap	2000 lb
Silica sand	880 lb
Limestone	640 lb

The weight of copper in the resulting melt is:

$$800 \text{ lb} - Cu \text{ in slag}$$
$$= 800 - 20 \text{ lb}$$
$$= 780 \text{ lb}$$

This is 97% of the melt weight, which is, therefore, 800 lb.

Part of the 560 lb of tin, lead and zinc in the charge finds its way into the melt. This amounts to:

$$3\% \text{ of } 800 \text{ lb} = 24 \text{ lb}$$

A further fraction enters the slag to the extent of 3% (as $SnO-PbO-ZnO$), i.e.,

$$3\% \text{ of } 2000 \text{ lb} = 60 \text{ lb}$$

approximately equivalent to 55 lb of the metals. With the remainder recovered at an efficiency of 87%, this amounts to 87% of $(560-55-24) = 415$ lb.

The loss (mainly ZnO) = 60 – 65 lb.

Limestone requirements at 50% CaO, etc., content:

$$= (320/50) \times 100 = 640 \text{ lb}$$

Thus the charge sheet for 2000 lb scrap would read:

Scrap	2000 lb
Silica sand	880 lb
Limestone	640 lb

To be continued.

Snail Brand Spanners

A new range of double-ended forged carbon steel Snail Brand spanners, designated H15 and designed to British Standard requirements, has a 15° spearhead jaw and retains the price characteristic of the well-known pattern H range. Three finishes are available: rust-resistant black, black with bright heads, and plated. Sizes cover Whitworth up to 1¼ in., across-flats up to 2 in., and metric up to 46 mm. Sets are made up in all popular British and Continental sizes. With the appearance of these new spanners the original H and F series are being discontinued.

All Snail Brand products are now made in the new Coleshill factory of Thomas Smith & Sons of Saltley Limited.

Noise Level

Without attempting to deal in detail with the theory of noise levels and noise measurement this short article describes some basic facts about "noise" and in particular the aggregate effect of different noises, restricting descriptions to a practical engineering level

"NOISE" or sound is simply a pressure wave or, more exactly, a combination of pressure waves of different pitch and amplitude. As far as noise level is concerned, therefore, the simplest method of description or evaluation is the strength of the pressure wave or the sound level, as it is sometimes called. Actually there is a distinction between the two terms. The pressure of a sound wave or sound pressure is the actual or effective pressure, measured in whatever pressure units are convenient. The sound pressure *level* is designated in terms of *decibels*.

The relationship between the two—actual sound pressure and sound pressure level or decibels—does not follow simple conversion. It is necessary first of all to establish what is 'zero' sound pressure level (0 decibels). The relationship between the two then follows from the formula

$$\text{decibels} = 20 \log (P/P_o)$$

where P = sound pressure as measured

P_o = reference sound pressure

The obvious reference pressure is the smallest sound that can just be heard, zero sound pressure level then (theoretically) corresponding to a pressure smaller by an infinitesimal amount. This is an impractical definition, the solution being simply to adopt a standard figure for the smallest audible sound as zero decibels. The internationally recognised standard for this reference sound pressure (P_o) is 0·0002 dyne/sq cm (0·0002 millibar). The conversion formula thus reduces to

$$\text{decibels} = 20 \log (P/0{\cdot}0002)$$

where P is measured in millibars.

In the limiting case where $P = P_o$ the product is taken as zero—i.e. 0·0002 millibar sound pressure is equal to 0 decibel sound pressure level.

An interesting generalization now arises in that doubling the sound pressure increases the sound (pressure) *level* by 6 decibel over any part of the range. Trebling the sound pressure increases the sound pressure by 9·54 decibel; and quadrupling the sound pressure raises the sound level by 12 decibel. Increasing the sound pressure ten times adds 20 decibel to the sound level.

Now to consider the resultant noise level when two different sounds are combined. The resultant is far from being the sum of the two components, but is very much less, and is dependent on the *difference* between the two original sound levels. The greater this difference the *less* the increase in overall sound level. The *greatest* increase in overall sound level, in fact, arises when two sounds of the *same* sound level are combined—a fact which is not commonly appreciated—and even then the resultant sound level is only raised by a matter of 3 decibel.

This holds true regardless of the sound levels of the individual sounds, the *difference* in sound levels between the two determining the increase in overall sound level, as tabulated in Table I. This increase in sound level is then added to the highest (sound level) of the two original sounds to arrive at the overall sound level, if the two sounds are of different level.

This characteristic is somewhat comforting. Working in the vicinity of any relatively noisy machine, for example, the effect of another noisy machine being started up nearby cannot increase the overall sound level by more than 3 decibel, unless it is noisier than the original machine (as measured at the first operator's position). If it *is* noisier, then it raises the local noise level to its noise level, plus something less than 3 decibel contributed to the total by the original machine.

Exactly similar considerations arise with regard to the effect of background noise level on specific noise level measurements of any individual machine or noise-producer. With background noise present any sound level measurement at a particular machine, etc., will show a false (high) reading and the nearer the background noise approaches to the machine noise, the greater will be the error.

For most practical purposes the effect of background noise can be ignored unless its sound level approaches within about 10 decibel of the machine noise (or noise being measured). Lower background noise levels imply a correction of appreciably less than half a decibel. The necessary correction is again established on the *difference* of sound levels, but in this case the relationship is somewhat different, as given in Table II.

The difference in noise levels is established quite simply by measurement of the machine noise together with background noise (i.e. the overall noise level), and then measurement of the background noise alone. If the background noise approaches within 10 decibel of the overall noise, then the necessary dedendum from the measured overall noise can be found from Table II to arrive at the true noise level of the machine.

Table I.—ADDENDA FOR COMBINED NOISE LEVEL (approximate values)

Difference between two component sounds in decibels	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Addenda for combined noise level (decibels to be added to loudest component)	3	2·5	2·2	1·75	1·4	1·2	1	0·8	0·65	0·5	0·4	0·33	0·26	0·22	0·17	0·14	0·1

Table II.—DEDENDA FOR BACKGROUND NOISE

Difference between overall noise and machine noise in decibels	1	2	3	4	5	6	7	8	9	10	11	12
Dedenda (decibels)	7	4·5	3	2·3	1·8	1·4	1	0·75	0·6	0·4	0·3	0·2

How Not to Deal with Overhead Expenses

Fallacies of the percentage methods

By A Consulting Cost Accountant

THE effect on businesses generally if entry into the Common Market is decided upon is a topical subject and no one is able to take a clear view until the details are announced. The dabbler in equity shares has impressions based largely on usefulness of products and the possibilities of expanding markets or suffering severe competition. The individual manufacturer, however, whatever his interest in stock exchange quotations or the general interest in the country's economics, must reduce the problems to "me" and "my". He will know from study and experience, no doubt, the particular sales field and the capabilities in quality of the foreign competitors. Another factor is the very important one of selling prices. Experience in his trade will indicate the general levels of others' prices with which he will have to compete, but his own must be fair and reasonable.

How many manufacturers can fix and adjust selling-prices in the confidence that they are based on accurate costing methods? The answer to this question is that few have reliable details of manufacturing costs; there is reliance on hunches, estimating (better described as guess work) and the taking of chances with a hope that if there is a wide variety of products there will be a profit figure in aggregate.

One manufacturer may consider that such a description does not apply to him because he does calculate the costs on which the selling-prices are determined, but is he, in innocence, using costing methods which are misleading? A few moments devoted to this question cannot be other than beneficial especially if he has a wide variety of selling-lines and numerous selling-prices.

Normally, labour and material costs are fairly accurate; the operations and the amount of material required can be determined by an intelligent check by someone of technical experience. Overhead expense—the third element—however, is complex, and inaccurate treatment is usually the cause of unfavourable results. It is still more disturbing when the accounting system provides only for the presentation of an aggregate profit and loss account some time after the end of the financial year—too late for corrective action.

In most industries the overhead expenses are treated in costs much too lightly. Many years ago expenses other than labour and materials were of low proportion: in fact, it was usually the practice to calculate the costs of material and of working and then add a sum for other expenses and profit, this depending on the selling-price already in mind.

Nowadays, it must be realized that the element of overhead expense is a high proportion of manufacturing cost. All costs have suffered increases in amount throughout the years, but invariably those in the overhead expense element have been most significant. Why then shipshod methods of treatment when building-up the cost of a manufactured article?

A common error is to regard the volume of overhead expenses as affected by the volume of direct labour. The amounts to be paid for direct labour and overhead expenses are budgeted in total for the current period then applied as a percentage: e.g. direct labour £50,000, overhead expenses £100,000, then 200%. This when applied means that if the labour cost of an article is one shilling then the overhead share is two shillings; if five shillings, then ten shillings, etc.

Perhaps the simplicity of method is the reason why it is used, but where there are numerous products with varying degrees of labour content the inaccuracies, too, are numerous.

Assume, for one example, that a junior operator performs one hour's work using an expensive machine at the labour cost of 3/-, and a skilled operator performs one hour's work at the bench at 5/-. The overhead percentage is 200. Costs are calculated thus:

	Machine	*Hand*
Direct labour	3 0	5 0
Direct material (say) ...	2 0 0	2 0 0
Overhead expense	6 0	10 0
	£2 9 0	£2 15 0

It will be seen that despite the machine depreciation, maintenance and fuel costs, the sum of 6/- only is included for one hour whilst 10/- is included when there are no such costs. The anomaly can be extended by suggesting the calculation of the cost if the young operator receives a birthday increase to 4/6 (the machine becomes 50% more expensive to run), or if he were to receive 9d. bonus for speedy work the machine depreciation and other costs would increase to 7/6.

If the business should be one which fixes selling-prices according to calculated costs, that of the machine-made article is much too low and of the hand-made article much too high.

If the overhead expenses do not rise and fall according to the amount of direct labour employed and, as stated earlier, it is incorrect to recover overhead expenses according to the labour content in a product cost, the error is still greater if recovered—as in a few cases—according to prime cost, i.e. direct labour and material. One example (an actual experience) is offered:

	Product A	*Product B*
Direct labour	2 0	18 0
Direct material (say) ...	18 0	2 0
	£1 0 0	£1 0 0
Overhead expenses at 50%	10 0	10 0
Total cost	1 10 0	1 10 0
Profit	3 0	3 0
	£1 13 0	£1 13 0

In this instance although product B was in the factory nine times as long as product A the same overhead expense was applied. Increasing sales of B at the expense of A caused reducing profitability.

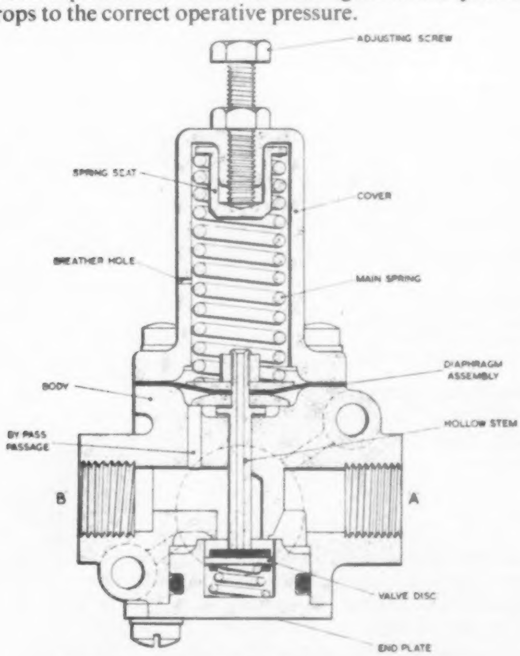
In almost every type of business, competition is becoming keener and keener; certainly design, quality,

presentation and delivery are matters to be considered when competing with the foreign or any other competitor, but whatever the success in those directions everything depends on selling-prices and no manufacturer requires much emphasis on this point. It is suggested, however, that he should do a little "stock-taking" on his costing methods especially if he is dealing with overhead expenses the percentage way—the wrong way.

Limiting Valve

A new Westinghouse valve for limiting air pressure has been designed for fitting in a pipe line or on the end of a reservoir, and has a setting range of 25-125 psi. It consists of a die cast body, and a cover which contains the main spring and spring seat, and an adjusting screw for setting the spring load. The body contains the pipe connexions and locating holes for mounting, together with a detachable end plate recessed to take the spring loaded valve disc. A diaphragm assembly is located in the body, the hollow stem of which rests against the face of the valve disc, while the diaphragm is clamped between the body and the cover.

In operation, air from the high pressure side enters the valve through port A and has a free passage past the valve disc to port B and the by-pass passage to the underside of the diaphragm. As the pressure builds up sufficiently to overcome the spring setting, the diaphragm assembly moves upwards allowing the valve disc to seat, shutting off further supply of air. As the air pressure is used from the low pressure side, the resultant drop in pressure allows the main spring to re-assert itself and unseat the valve disc, thus repeating the cycle. Should pressure on the low pressure side of the valve build up above the required operating pressure, the increased deflexion of the diaphragm will allow the hollow stem to move away from the valve disc after it has been seated, letting air through to the cover to bleed away to atmosphere. The stem will seat again as the pressure drops to the correct operative pressure.



Westinghouse limiting valve for pipe line or reservoir fitting

The valve is an addition to the range of pneumatic control equipment made by Westinghouse Brake and Signal Company Limited, Hanham Road, Kingswood, Bristol.

New Gasket Material

A new high-density asbestos gasket material that meets the physical requirements of AMS 3232G, ASTM D-1170-59T and MIL-A-17472 (Navy) is announced by Armstrong Cork Company Limited, Honeypot Lane, Kingsbury, London NW9. Called Accopac AN-892, it is a tough asbestos sheet that combines flexibility with high density and conformability with low compressibility. Its performance stems from a uniform distribution of asbestos fibres and nitrile rubber binder. The material die cuts cleanly and has practically no tendency to "powder". The makers recommend it for use where service conditions require a dense, flexible gasket with low compressibility. This would include heat exchangers, heavy duty compressors and pumps, and steam turbines. It is also suitable for pipe flange, valve, and cover gaskets in the routine maintenance of chemical processing plants and equipment, petroleum refineries and allied installations.

PVC Storage Tanks

A new range of storage tanks is being produced by Turner & Brown Limited, Bolton, Lancashire, under the trade mark Turbro-Cyclone, to provide an economical means of containing the many acids, alkalis and other corrosive liquids now used in industry. The tanks are constructed from rigid PVC sheet bonded and wrapped with resin-impregnated glass fibre. They are light in weight and tanks of additional strength and rigidity are also made in wire-reinforced PVC using the same glass fibre bonded technique. Sizes are up to 20 ft. by 6 ft. by 6 ft. Flanged pipe connections can be provided with great accuracy and a close fitting lid can also be supplied with a built-in inspection port.

Bolts and Screw Fasteners

TO THE EDITOR OF MECHANICAL WORLD

Sir—I would congratulate the originator of the article on one of the important technical aspects of fasteners (M.W. May 1962, pp. 151-2). It is commendable that the author has successfully limited his theme to the extent that many will be able to understand and benefit from the information, and at the same time, realize that there will be similar issues involved in almost all mechanical fastenings.

I think there is only one relevant and important point omitted, and that is in respect of excessive clearance. In many applications shear forces can immediately destroy a highly stressed joint where the fastener is a poor fit. Lateral movement will simply tip the bolt head off. Hard washers must be emphasized in this application and all similarly highly stressed applications. In most common applications the washers do more harm than good. These matters require to be much more generally understood by designers and practical engineers.

On the whole, I find it refreshing that the writer has clearly made the disciplined effort to explain an important issue and skilfully avoided the pitfall of blinding his readers with the academic language of science. But is it quite safe to presume that readers understand the principles involved in pre-stressing?

Your faithfully

London, SW6. Barrie Baxter

Bernard Collins Ltd

Production of Components with Extruded Necks—III

Concluding the presentation of complete data for producing necks to suit the principal screw thread forms in a range of sizes

By W. RICHARDS, A.M.I.Prod.E.

As stated earlier, if the material used for the extruded neck component falls below a certain minimum thickness, the neck will burst under the full load the screw is capable of carrying.

Fig. 3 shows a section of an extruded neck component, the screw is not shown but it is assumed to be supporting a total load W which is resolved into two reactions R, one for each half of the component. The reaction R is further resolved into two forces, one ($\frac{1}{2}W$) acting parallel to the axis of the screw, the other B_t acting perpendicular to the axis. The force B_t is modified by friction, to be considered later.

Load $\frac{1}{2}W$ is carried by the thread on each half of the component; B_t is the force tending to burst the component.

Force B_t is divided among all the threads and acts around the whole circumference, conditions being similar to those obtaining in the case of a tube loaded internally by hydraulic pressure; under excessive pressure the tube would be ruptured longitudinally. For a given load W, force $\frac{1}{2}W$ will remain constant irrespective of the screw thread angle, but forces R and B_t will increase as the thread angle θ increases; otherwise as the thread angle θ decreases, the forces R and B_t will decrease. Relating the bursting force B_t to the total load W, we have,

$\frac{1}{2}W = R \cos \frac{1}{2}\theta$, $W = 2R \cos \frac{1}{2}\theta$, $R = W/(2 \cos \frac{1}{2}\theta)$

$B_t = R \sin \frac{1}{2}\theta = (W \sin \frac{1}{2}\theta)/(2 \cos \frac{1}{2}\theta) = 0W \tan \frac{1}{2}\theta$

For the BA system,

$\frac{1}{2}\theta = 23° 45'$; $\tan \frac{1}{2}\theta = 0{\cdot}44$; $B_t = 0{\cdot}44\, W/2 = 0{\cdot}22\, W$

For the Whit. system,

$\frac{1}{2}\theta = 27° 30'$; $\tan \frac{1}{2}\theta = 0{\cdot}52$; $B_t = 0{\cdot}52\, W/2 = 0{\cdot}26\, W$

For the 60° system,

$\frac{1}{2}\theta = 30° 00'$; $\tan \frac{1}{2}\theta = 0{\cdot}577$; $B_t = 0{\cdot}577\, W/2 = 0{\cdot}288\, W$

Friction between the threads of screw and extruded component will tend to reduce the bursting force below that derived above. Assuming a coefficient of friction between contacting surfaces of screw and extruded component to be 0·132, the angle of friction ϕ is the angle whose tangent is 0·132 or 7° 30′.

Reducing the angle $\frac{1}{2}\theta$ by the value of the friction angle ϕ, we have,

Actual bursting force,

$B = \frac{1}{2}W \tan (\frac{1}{2}\theta - \phi)$ . . . . (3)

Thus for the BA system,

$B = \frac{1}{2}W \tan (23° 45' - 7° 30') = \frac{1}{2}W \tan 16° 15'$

$= \frac{1}{2}W \times 0{\cdot}29$

$B = 0{\cdot}145\, W$ . . . .(3a)

For the Whit. system,

$B = \frac{1}{2}W \tan (27° 30' - 7° 30') = \frac{1}{2}W \tan 20° 00'$

$= \frac{1}{2}W \times 0{\cdot}364$

$B = 0{\cdot}182\, W$ . . . . (3b)

For the 60° system,

$B = \frac{1}{2}W \tan (30° 00' - 7° 30') = \frac{1}{2}W \tan 22° 30'$

$= \frac{1}{2}W \times 0{\cdot}414$

$B = 0{\cdot}207\, W$ . . . . (3c)

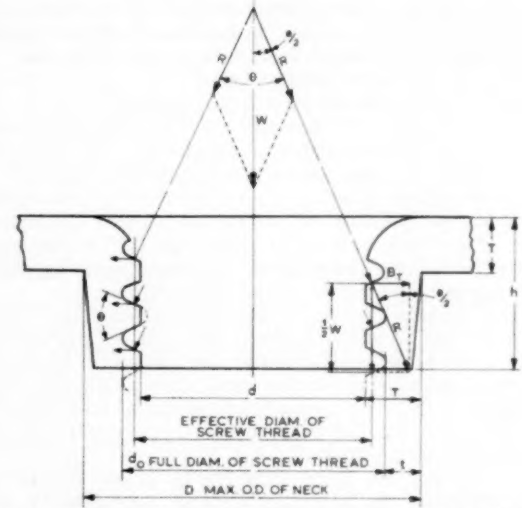


Fig. 3.—Diagram used in derivation of bursting strength—dia D and minimum thickness T

From the above it will be noted the BA thread system has an advantage over others in respect of lower bursting pressure. According to formula (3a), for BA thread the bursting pressure is equal to 0·145 of the total load W carried by the screw. Assuming screw and extruded neck Fig. 2 are of similar material, and as stress under load is tensile for both members, then the sectional area of the neck should be at least 0·145 that of the screw at its root diameter, for the frictional conditions assumed above.

Designate the numerical parts of formulae 3a, 3b and 3c by C, the area ratio. Referring to Fig. 3, the minimum thickness t of the neck required to resist the bursting pressure B is measured as shown from the top of the screw thread, to the outside diameter D. Since the screw thread is mainly contained in the actual neck, which will always be tapered, compensation will be attained if we consider the full diameter of the screw instead of its root diameter in assessing its area. This will have the effect, in the following, of increasing the sectional area of the neck, thus providing for the loss of area due to the taper, and provide a margin of safety. The cross sectional area of the neck is equal to,

$$(D - d_o)h$$

Area of screw, full diameter, $= 0{\cdot}7854\, d_o^2$

Required cross sectional area of neck, $= 0{\cdot}7854\, d_o^2 \times C$

Where C is the area ratio $h = 0{\cdot}5\, d_o$ (formula A)

Then $(D - d_o)\, h = (D - d_o)\, 0{\cdot}5\, d_o = 0{\cdot}7854\, d_o^2 \times C$

Solving for D $\quad D - d_o = (0{\cdot}7854\, d_o^2 \times C)/(0{\cdot}5\, d_o)$

$D = 1{\cdot}571\, d_o\, C + d_o$ . . . (4)

For the BA system, where $C = 0{\cdot}145$

$$D = 1{\cdot}571\, d_o \times 0{\cdot}145 + d_o$$
$$= 0{\cdot}238\, d_o + d_o$$
$$= 1{\cdot}238\, d_o \quad \ldots\ldots \quad (4a)$$

For the Whit. systems, where $C = 0{\cdot}182$

$$D = 1{\cdot}571\, d_o \times 0{\cdot}182 + d_o$$
$$= 0{\cdot}286\, d_o + d_o$$
$$= 1{\cdot}286\, d_o \quad \ldots\ldots \quad (4b)$$

For the American 60° thread systems, where $C = 0{\cdot}207$

$$D = 1{\cdot}571\, d_o \times 0{\cdot}207 + d_o$$
$$= 0{\cdot}325\, d_o + d_o$$
$$= 1{\cdot}325\, d_o \quad \ldots\ldots \quad (4c)$$

Having derived an expression giving the outside diameter of the extruded neck for the three screw thread systems commonly in use, we finally require one giving the minimum thickness T of the material to be used in the production of the component.

Let, T = minimum thickness of material

D = outside diameter of the extruded neck (from formulae 4a, 4b or 4c)

d = tapping size = plunging punch diameter.

Then, from Figs. 2 and 3, $T = \frac{1}{2}(D-d) \quad \ldots\ldots \quad (5)$

Mild steel has been considered throughout this article but if the same material is used for both screw and component, the whole of the formulae given herewith are applicable to any reasonable proposition.

The formulae presented in this article are applicable only to the basic component—the first in any group. The total height of the basic component is taken as being equal to one half the full diameter of the corresponding screw. The diameter of the initial hole is equal to one half the diameter of the tapping size, or the plunging punch diameter.

The second and third components, or any following, are increased in total height by a reduction in the diameter of the initial hole as shown in the tables. The charts also give all necessary data in this respect.

The whole procedure to be taken with regard to the basic extruded neck component, including the application of all essential formulae, is as follows.

Example, an extruded neck component is required for tapping with a No. O BA screw thread. Determine the outside diameter of the neck, and the minimum thickness of the material to be used.

1. Tapping size = punch diameter.
   By formula 2. $d = d_o - 1{\cdot}26\, d_t$, where, $d_o = 0{\cdot}236$ in; $d_t = 0{\cdot}0236$ in. $= 0{\cdot}236 - 1{\cdot}26 \times 0{\cdot}0236 = 0{\cdot}206$ in.
2. Outside diameter of extruded neck.
   By formula 4a. $D = 1{\cdot}238\, d_o$, where, $d_o = 0{\cdot}236$
   $= 1{\cdot}238 \times 0{\cdot}236 = 0{\cdot}292$ in.
3. Minimum thickness of material
   By formula 5. $T = \frac{1}{2}(D-d)$ where, d = tapping size $= 0{\cdot}206$ in.
   $= \frac{1}{2}(0{\cdot}292 - 0{\cdot}206) = \frac{1}{2} \times 0{\cdot}086$
   $= 0{\cdot}043$ in.

It will be noted that all components included in Table I, are made in 0·046 in. material, but all following the O BA group could be made in a reduced thickness.

For example, determine the minimum thickness of material required for the 2 BA series. By formula 2 the tapping size is found to be, $d = 0{\cdot}160$ in. dia; the full diameter of the screw $d_o = 0{\cdot}185$ in.

Outside diameter of the extruded neck.

By formula 4a. $D = 1{\cdot}238\, d_o = 1{\cdot}238 \times 0{\cdot}185 = 0{\cdot}230$ in.

Minimum thickness, $T = \frac{1}{2}(D-d) = \frac{1}{2}(0{\cdot}230 - 0{\cdot}160)$
$= \frac{1}{2} \times 0{\cdot}070 = 0{\cdot}035$ in.

Thus, as a minimum, 20 swg = 0·036 in. thick material could be used.

Example. Required an extruded neck component to be tapped ¼ in. BSF thread. By formula 2. Tapping size $d = 0{\cdot}219$ in. dia; $d_o = 0{\cdot}250$ in. dia.

Outside diameter of extruded neck.

By formula 4b. $D = 1{\cdot}286\, d_o = 1{\cdot}286 \times 0{\cdot}250$
$= 0{\cdot}321$ in.

Minimum thickness, $T = \frac{1}{2}(D-d) = \frac{1}{2}(0{\cdot}321 - 0{\cdot}219)$
$= \frac{1}{2} \times 0{\cdot}102 = 0{\cdot}051$ in.

Thus, as an absolute minimum, 18 swg = 0·048 in. material could be used.

Example. Required an extruded neck component to be tapped ¼ in. BSW thread.

By formula 2. Tapping size $d = 0{\cdot}209$ in.; $d = 0{\cdot}250$ in.

Outside diameter of extruded neck.

By formula 4b. $D = 1{\cdot}286\, d_o = 1{\cdot}286 \times 0{\cdot}250$
$= 0{\cdot}321$ in.

Minimum thickness, $T = \frac{1}{2}(D-d) = \frac{1}{2}(0{\cdot}321 - 0{\cdot}209)$
$= \frac{1}{2} \times 0{\cdot}112 = 0{\cdot}056$ in.

Example. Required an extruded neck component to be tapped ¼ in. × 20 tpi American National Coarse Thread (angle 60°).

By formula 2. Tapping size, $d = d_o - 1{\cdot}26\, d_t$; where $d_t = 0{\cdot}0325$ in.
$= 0{\cdot}250 - 1{\cdot}26 \times 0{\cdot}0325 = 0{\cdot}250 - 0{\cdot}041 = 0{\cdot}209$ in.

Outside diameter of extruded neck.

By formula 4c. $D = 1{\cdot}325\, d_o = 1{\cdot}325 \times 0{\cdot}250$
$= 0{\cdot}331$ in.

Minimum thickness, $T = \frac{1}{2}(D-d) = \frac{1}{2}(0{\cdot}331 - 0{\cdot}209)$
$= \frac{1}{2} \times 0{\cdot}122 = 0{\cdot}061$ in.

In this case, 0·0625 in. material is the minimum. Thus for the 60° thread system slightly thicker material is required for the component, due to the higher bursting pressure exerted by the screw under load.

A change in the percentage depth of thread value x in formula 1 involves no change in formulae 4 and 5.

If it is desired to increase the percentage x to, say, 75% of a full thread, then by formula 1,

Tapping size = punch diameter $= d = d_o - x.2.d_t$
$= d_o - 0{\cdot}75 \times 2 \times d_t$

Formula 2 becomes $d = d_o - 1{\cdot}5\, d_t$

Reconsidering component No. 1, Table I, for O BA, and tapping for a 75% full thread,

then, $d = 0{\cdot}236 - 1{\cdot}5 \times 0{\cdot}0236$
$= 0{\cdot}236 - 0{\cdot}036 = 0{\cdot}200$ in.

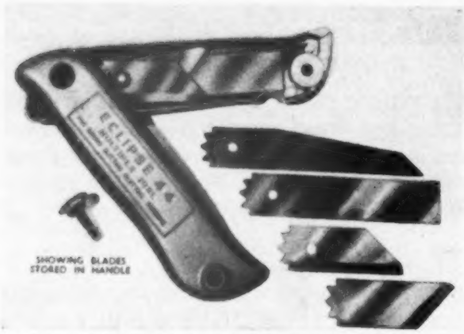
The outside diameter D of the neck, previously obtained = 0·292 in., then minimum thickness of material required will be,

By formula 5, $T = \frac{1}{2}(D-d) = \frac{1}{2}(0{\cdot}292 - 0{\cdot}200)$
$= \frac{1}{2} \times 0{\cdot}092 = 0{\cdot}046$ in.

From Fig. 3, it will be noted the increased value of d_t has no effect on the value of t, but modifies the value of T as above.

Adhesive Asbestos Webbing and Tape

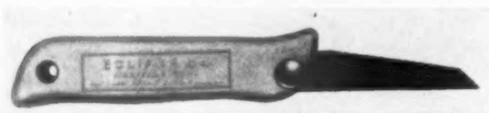
All the webbing and asbestos listing tapes manufactured by Turner Brothers Asbestos Company Limited, Rochdale, are now available backed with a pressure sensitive adhesive. Based on vinyl ethers, the adhesive film is thermo-plastic, but the bond remains firm up to about 100°C. It sticks to virtually any material, is non-toxic and has no effect on the electrical properties of the asbestos materials. Typical uses are fuse and switch boxes, linings, hand-wrappings for electrical equipment and sealing for inspection doors, hot air ducts, flanges etc.



The new Eclipse multiple tool. The blades are stored in the body

Multiple Tool

An addition to the Eclipse range of tools made by James Neill and Company (Sheffield) Limited, Sheffield 11, is the No. 44 Multiple Tool. This is a compact, self contained outfit having four blades for sawing, slotting, slitting and scribing, which, when not in use, can be housed in the handle. Each blade can be positioned at any one of four different angles. The blades are made from heat-treated high grade steel. The die cast handle is light in weight and comfortable in the hand. It consists of two inseparable halves which swivel at one end and are secured at the other end by an easily manipulated screw. The complete tool retails at 8/6d. each.



A blade mounted for use. Four different blade positions are provided

Paint for Danger Points

A new product for the painting of danger points in factories, workshops, and on machinery of all descriptions where vivid portrayal is necessary, is Humbrol Hi-Glo fluorescent paint, manufactured by the Humber Oil Company Limited, Hull. It is available in both gloss and matt, and must be applied, either by brush or spray, over a white base coat, which has been specially formulated for the purpose. Both finishes dry in approximately 1 hr. Special thinners are required for the matt finish but not for the gloss or base white. The matt finish gives the most vivid colour, but where dirt contamination is high, the gloss, although slightly less vivid, gives better service as it can be cleaned down more easily. Colours are: Fire Orange, Aurora Pink, Blaze, Saturn Yellow and Signal Green.

Capsula Control Valve

A medium shock phenolic capsule, a brass base plate and mechanism block—this is basically the Capsula valve designed and manufactured by Industrial Pneumatics Limited, Uxbridge. Valves in the Capsula range—designed to accommodate outside pipe sizes of $\frac{5}{32}$ in. $\frac{5}{16}$ in. and $\frac{1}{2}$ in.—are made in two parts: a capsule and a base. The capsule consists of a number of body sections—one for each valve port—and two end covers. Alkathene seals loaded with colloidal graphite are trapped between the body sections. These seals are static and ensure minimum pressure loss in the body of the valve when the hard dural piston is motivated.

Standard medium shock phenolic body sections are held together and fixed to their self-contained brass mechanism block by means of tie rods, while the complete capsule is screwed to its base and the joints sealed with O-rings. Throughout the range, design of basic components is the same—most working parts are common to more than one valve.

Mechanism within the valve—with the exception of the lever model—is indirectly operated by means of a small built-in pilot valve. Movements and thrusts are therefore short and light. Solenoid actuators can also be utilized (most voltage ratings can be provided for with low temperature rise and current consumption). All pipe connections are on one face of the base and are tapped for the direct connection of solderless fittings. Designed pressures are up to 150 psi but they have been tested to a maximum 600 psi without leakage. Sole selling agents are I. V. Pressure Controllers Limited, 683 London Road, Isleworth, Middlesex.

Flame Plated Cutters

Flame plated spotfacing cutters giving three times as many holes as high speed steel cutters per re-grind and, on an operation on which tungsten carbide cutters shattered, is reported by Crane Limited, of Ipswich. The operation is typically on $\frac{5}{8}$ in. dia holes, spotfaced to $1\frac{1}{4}$ in. dia.

Flame plating is a specialised method of improving wear resistant cutting surfaces by the deposition of a thin, tough, hard layer of tungsten carbide powder, by "firing" it on to the workpiece in a plasticised form, from a special gun. The process is carried out at the Union Carbide Limited Flame Plating Department, Millers Road, Warwick.

Metal Cleaners

The Metal Industries Department of Diversey (U.K.) Limited have announced two new cleaning compounds: Diversey H.D.S., a caustic-based, heavy duty spray cleaner for ferrous components, pressings, etc., where a fine surface etch is required, and Diversey Distel, an inhibited alkaline electrocleaner for use on steel, brass and copper. It is in powder form, readily soluble in water, non-dusting and non-caking.

Spring Feed Lubricator

Tecalemit (Engineering) Limited, Plymouth, Devon, announce the introduction of a new spring feed lubricator. This lubricator, which is charged from a lubricating hand gun or bulk dispenser through a nipple has an O-ring to prevent the seepage of oil in case it separates out from certain greases due to spring pressure, and a piston stop to prevent coil locking of the spring. The outlet adjusting screw has a fine pitch which gives an accurate adjustment of output. These lubricators for fitting directly on to bearings have a tell-tale rod fitted to indicate the level of lubricant. Having a 2 oz grease capacity the standard unit has a $\frac{1}{4}$ in. B.S.P. male outlet, and is fitted with either a TAT hexagon or a hydraulic headed nipple. The lubricator Pt. No. IB 4351 is priced at £1. 17s. 6d. retail.

Research into the Irons

Iron was once thought of as a simple metal with known and desirable properties. Today it is not only regarded as complex in composition and manufacture, but there are new irons with properties and functions still not fully explored. In the following notes some of the researches carried out over the last seven or eight years are summarized

GASES in metals have been considerably investigated but their effect on cast iron was, up to 1954, a mystery that had not been fully examined. One phenomenon, however, was known, namely that many irons had a high oxygen content when very old. It is quite possible that the high oxygen content of these irons originated while they were in service and was not an essential part of the original material. After a thorough study of such information on this point as was available, and the carrying out of new experiments using vacuum fusion analysis, it was suggested that reported values above 0·002% should be regarded with suspicion. They are probably the result of unsound specimens or those with small amounts of entrapped oxides or slags.

The British Cast Iron Research Association, for example, having exhaustively studied gases in high silicon cast irons, decided that the raw materials were the main source of high gas content in the product, and rusty light scrap was believed to be the principal cause of oxygen pick-up. A correlation has now been made between the actual oxygen values by vacuum fusion analysis and the equilibrium values calculated for the silicon-oxygen reaction. This was achieved in the United States.

Notch ductility has become increasingly important in choosing materials for engineering applications. There was great need for the evaluation of this property of ductile or nodular irons, to supplement the comprehensive data on tensile properties. The brittle fracture of castings subjected to impact and explosion loading was therefore investigated as regards the resistance of various irons of nodular type.

It was found that the transition range of Charpy energy curves is the important criterion correlating resistance to fracture. The energy values associated with fibrous fractures are not significant in this respect. The best possible notch toughness is obtained with fully ferritized material of low silicon and phosphorus contents. Comparison with cast and rolled steels shows that fully ferritized nodular irons of existing commercial composition do not resist brittle fracture so well as the steels.

In an article some time ago the writer gave an account of the effect of boron in steel. The solubility of boron in gamma and alpha iron and the effect of the element on the gamma-alpha transformation in iron was little understood and the need was to determine the essential features of the Fe-Fe_2B phase diagram, Fe_2B being the first intermediate phase in the iron-boron system. On the basis of comparative solubilities and the size of the interstitial hole in alpha and gamma irons, it was tentatively concluded that boron forms a substitutional solid solution in alpha iron and an interstitial solid solution in gamma iron.

Rolling textures in iron have been the subject of research. Pole figures for cold rolled iron have been described in terms of ideal orientations. Pole figures for iron containing 4·6% silicon have been published and are almost identical with these. However, increasing carbon content has been shown to cause an increasing randomness of the texture. The recrystallized texture of iron has also been analyzed and can be described in terms of two orientations. The recrystallized textures reported for iron silicon alloys are not consistent, but have been found to resemble those for iron containing 4·6% silicon, and in another instance to be describable in terms of a different orientation.

Ingot iron is of relatively high purity, produced in the open hearth furnace under conditions that keep down the carbon, manganese and silicon content. Armco iron is a typical example. Substructures have been observed in ferrites of pure and commercial iron of low carbon content that have undergone the transformation of gamma to ferrite. The sub-boundaries in the ferrite are believed to be the result of internal stress accompanying transformation, and cause later polygonization. The effect of these sub-boundaries on the properties of ferrite had not been fully evaluated and an investigation was undertaken into the effect of such sub-boundaries on notch toughness in commercial ingot iron, which exhibits appreciable sub-boundaries.

In addition, the distribution of carbide could be changed by cooling in the furnace, and therefore the effect of carbide dispersion was evaluated. It was reported that the amount of sub-boundaries in the ferrite was controlled by the cooling rate through the gamma-alpha transformation. Carbide dispersion was changed by furnace cooling and by solution treatment followed by quenching and ageing. Charpy V-notch transition temperature of the ferrite with a constant sub-grain size was found to increase about 20°F with an increase in one ferrite grain size number. Carbide distribution notably influenced the notch toughness; and an increase in sub-boundaries increased the transition temperature particularly in solution-treated, quenched and aged, ingot iron.

The failure of metal components is usually characterized by fractures of cleavage type presenting a brittle appearance and showing small indication of deformation before fracture developed. Until recent years, the unanticipated, non-ductile failure of metals which had shown good ductility when tested for tensile properties created a good deal of confusion concerning the interpretation of tensile tests. It is now known that ductility in tensile tests is only significant for service conditions where the surfaces are entirely smooth and free from notches.

A survey was made of the notch ductility properties of malleable irons for use at low service temperatures and resulted in the presentation of a quantitative measure of the impact behaviour of malleable irons, including the effect of notch, low temperature, section thickness and chemical composition. Properly made malleable irons have been shown to be inherently notch ductile and suitable for low temperature service. The material can be ruptured in shear with comparatively low absorption of

energy as long as excessively high overloads are developed. Lowering the phosphorus content of malleable irons by whatever means are available will improve their resistance to brittle failure.

Certain mechanical properties of grey cast iron have been studied by means of thin-walled combined stress specimens, immersion type density measurements and microscopic methods. Little or no elastic behaviour has been observed. Density decreases during plastic deformation. This change is a smooth function of applied stress, and is greater for biaxial tensile stressing than for uniaxial stresses. It seems to be caused by the opening up and separation of the graphite from the matrix material. Other characteristics of deformation and rupture have also been noted.

One of the fundamental reasons for the extensive employment of ferrous alloys is their ability to respond to heat-treatments capable of developing a considerable range of mechanical properties. This is because of their allotropic transformation, i.e. their ability to change from one state to another without losing their character as ferrous materials, and also because carbon is much more readily dissolved by gamma than by alpha iron. Not enough was known, however, regarding the mechanism by which the allotropic transformation is achieved in iron of high purity. In consequence, it was decided to study this mechanism by means of the thermionic emission microscope. It was ascertained as a result that this mechanism, when it comes into play at temperatures just below the Ae_3 temperature, is a shear mechanism. It was also revealed that as the degree of undercooling increases, the average length of the individual shears increases, and the average rest period between shears decreases. In other words, it has been shown that the transformation of austenite to ferrite does not proceed continuously in high purity iron, and that the mechanism is not one of nucleation and growth.

Some uncertainty has been expressed regarding the general validity of the criterion chosen by the investigators for discerning the mechanism, but in general it is evident that new light has been thrown upon an important subject.

The thermal conductivity of a metal is closely akin to its electrical conductivity, and it is essential that the engineer should know both for a given material. It is much more difficult to determine thermal conductivity by experiment, so that the possibility of relating it analytically to relatively simple electrical measurements has great attraction. The cast pearlitic irons and the annealed ferritic ductile cast irons represent instances in which there is a great difference between the conductivities of the dispersed phase (graphite) and the matrix (pearlite or ferrite). Recently the conductivities of these cast irons have been determined and related to the amount, size, shape and structure of the phases present. A number of methods for calculating the conductivity of a two-phase aggregate and a technique for quantitative metallography have been applied.

It has been shown that maximum thermal conductivity in ductile cast iron is obtained when the material is in the fully annealed state with maximum carbon content and minimum silicon content. A high graphite content appears to result in high conductivity, which seems to contradict previous statements by research workers. It appears, however, as a result of confirmatory data published, that the original statement was based on the analogy of truly metallic behaviour, whereas in cast irons the normal metallic relation between conductivities does not seem to obtain. This is because graphite is present in the microstructure.

In hot forging intricate forms, a large number of intermediate operations are frequently necessary to finish a specific component. One means of raising production is to lessen the number of these intermediate stages. It was recently decided to find out what would be the effect of small forging reductions on the resulting mechanical properties of a ferrous material, such as iron, and to investigate other factors liable to affect this relation. It was suggested as a result that the ductility may be improved by closing the pores remaining in the cast structure, and a number of effects of forging on non-metallic inclusions are suggested, together with what is called 'breaking up' of areas of segregation, which would also improve ductility. Losses in axial ductility apparently follow on forging the ingot iron material containing high sulphur.

It appears to be agreed by experts who have considered these results that further economy analysis as well as research are required, as the research dealt with only a simple upset operation and various factors of importance were not dealt with.

New Motor Starter

A new low-cost motor starter, Type DOC.220, has been introduced by the Motor and Control Gear Division of Associated Electrical Industries Limited. It has all the features of the popular Type DOC.80 unit and is for use with three-phase a.c. squirrel-cage motors up to 15 hp and single-phase motors up to $7\frac{1}{2}$ hp. A feature is the protection given against single-phasing on three-phase supplies by an overload relay which incorporates an ambient temperature compensator. Two auxiliary changeover switches can be supplied in separate packs. There are nineteen different heater ratings and overload heaters are supplied separately and can be easily and quickly fitted.

Preliminary Design of Gas Turbine Plant–VI

Selecting the main dimensions of the compressor

By W. R. THOMSON, B.Sc.Tech.

8. Compressor calculations

8.1. Cycle calculation results

The following results are brought forward from the cycle calculations of sect. 6:

$Q_{air} = 44{\cdot}60$ psi, $P_{in} = 14{\cdot}2$ psi, $T_{in} = 288°K.$, $P_{out} = 71{\cdot}00$ lb/sec. $T_{out} = 482°K.$, $\delta H = k\,\delta T = 46{\cdot}69$ chu/lb, $k = 0{\cdot}2415$, $\gamma = 1{\cdot}397$, $\eta_x\,\gamma/(\gamma-1) = 3{\cdot}135$. Further, steel blading is assumed to specn. S80 and a "factor of safety" of 5.

In the sections which follow, numbered under main section 8, the section numbers in parenthesis refer to the design notes of main section 7.

Generally the design calculations can be carried out under two columns headed "first stage" and "last stage". Where calculations are general the dividing space is omitted and the work spreads across the page. The sequence of section numbers (under 8) shows the order of carrying out the calculations.

First Stage	Last Stage

8.2 (7.6.6)

$$\frac{P_{in}}{P_{out}}\sqrt{\frac{T_{out}}{T_{in}}}=\frac{14\cdot2}{71}\sqrt{\frac{481}{288}}=0\cdot259$$

$u_m\ \sqrt{288/T_{in}} = 750$

First Stage:

$M_{a\ in} = 0\cdot380$ from Fig. 12

(7.7) Table IV $\delta\gamma = 1\cdot397 - 1\cdot35 = 0\cdot047$

$Q\sqrt{T}/AP = 0\cdot2350 + 0\cdot0002 + 0\cdot0032 = 0\cdot2384$

$$A_{in}=\frac{44\cdot60\sqrt{288}}{0\cdot2384\times14\cdot2}=223\cdot3$$

$\frac{1}{4}\pi d_o^2 = 223\cdot3/0\cdot51 = 437\cdot5\ \therefore\ d_o = 23\cdot60$

Last Stage:

$M_{a\ out} = 0\cdot3$

$\delta\gamma = 0\cdot047$

$Q\sqrt{T}/AP = 0\cdot1915 + 0\cdot0025 = 0\cdot1940$

$$A_{out}=\frac{44\cdot60\ \sqrt{481}}{0\cdot1940\times71}=71\cdot2$$

$\frac{1}{4}\pi d_i^2 = 437\cdot5 - 71\cdot2 = 366\cdot3\ \therefore\ d_i = 21\cdot60$

$h = \frac{1}{2}(23\cdot60 - 21\cdot60) = 1\cdot00$

$d_m = 23\cdot60 - 1\cdot00 = 22\cdot60$

$N = 172{,}000/22\cdot60 = 7600$

8.3 (7.8 and 9.9) Data for the Turbine

$Q_{gas} = 45\cdot00,\quad P_{out} = 28\cdot10,\quad T_{out} = 829,\quad \gamma = 1\cdot35,\quad M_{out} = 0\cdot3$

Table IV: $Q\sqrt{T}/AP = 0\cdot1915,\quad A_{out}=\dfrac{45\cdot00\ \sqrt{829}}{0\cdot1915\times28\cdot10}=241\cdot4$

$\frac{1}{4}\pi d_o^2 = 241\cdot4/0\cdot64 = 377,\quad d_o = 21\cdot92,\quad d_i = 0\cdot6\times21\cdot92 = 13\cdot15.\quad N = 137{,}600/13\cdot15 = 10{,}460$

Hence turbine and compressor must run at 7600 rpm.

8.4 (7.9)

First Stage:

$d_i = 0\cdot07\times23\cdot60 = 16\cdot52$

$h = \frac{1}{2}(23\cdot60 - 16\cdot52) = 3\cdot54$

$d_m = 23\cdot60 - 3\cdot54 = 20\cdot06$

$u_m = 750\times20\cdot06/22\cdot60 = 665$

Table IV: $V_a/\sqrt{T} = 24\cdot25 + 0\cdot02 + 0\cdot384$

$= 24\cdot65\ \therefore\ V_a = 24\cdot65\sqrt{288} = 418$

$u_m/V_a = 1\cdot59$

Last Stage:

Mean

$u_m = 750$

Table IV: $V_a/\sqrt{T} = 19\cdot23 + 0\cdot319 = 19\cdot55$

$V_a = 19\cdot55\ \sqrt{481} = 419$

$u_m/V_a = 1\cdot79$

8.5 (7.10) Tip

$u_o = 665\times1/0\cdot85 = 782$

$u_o/V_a = 782/418 = 1\cdot872$

$Tan\ \alpha_1 = \sqrt{0\cdot36/0\cdot380^2 - 1} = 1\cdot222$

$$\text{Reaction}=\frac{Tan\,\alpha_1+Tan\,\alpha_2}{2u_o/V_a}=0\cdot55$$

$Tan\ \alpha_1 + tan\ \alpha_2 = 2\times0\cdot55\times1\cdot872 = 2\cdot060$

$Tan\ \alpha_2 = 2\cdot060 - 1\cdot222 = 0\cdot838$

$Tan\ \alpha_o + tan\ \alpha_1 = u_o/V_a = 1\cdot872$

$Tan\ \alpha_o = 1\cdot872 - 1\cdot222 = 0\cdot650$

$Tan\ \alpha_2 + tan\ \alpha_3 = u_o/V_a = 1\cdot872$

$Tan\ \alpha_3 = 1\cdot872 - 0\cdot838 = 1\cdot034$

$$k\Delta T_1=\frac{782\times418\,(1\cdot222-0\cdot838)}{gJ}=2\cdot785$$

8.6 (7.11) Mean

$s/c = 0\cdot7\times22\cdot60/21\cdot60 = 0\cdot732$

Fig. 11: $Tan\ \alpha_1 = Tan\ \alpha_3 = 1\cdot215$

$Tan\ \alpha_o = Tan\alpha_2 = u_m/V_a - 1\cdot215$

$= 1\cdot79 - 1\cdot215 = 0\cdot575$

$$k\,\Delta T_o=\frac{750\times419\,(1\cdot215-0\cdot575)}{45\,080}$$

$= 4\cdot46$

8.7 (7.12)

$$n\,(1+x)=\frac{2\times46\cdot69}{0\cdot86\,(2\cdot755+4\cdot46)}=14\cdot98=15\,(1-0\cdot0013)$$

Hence 15 stages are required.

8.9 (7.14) Mean

$Tan\ \alpha_1 - Tan\ \alpha_2 = 0\cdot384\times782/665$

$= 0\cdot4515$

$Tan\ \alpha_3 = 1\cdot034$

$Tan\ \alpha_2 + Tan\ \alpha_3 = 1\cdot59\ \therefore\ Tan\ \alpha_2 = 0\cdot556$

$Tan\ \alpha_1 = 1\cdot0075$

$$\text{Reaction}=\frac{1\cdot5635}{2\times1\cdot59}=49\cdot2\%$$

8.8 (7.13)

$$Tan\ \alpha_1 - Tan\ \alpha_2=\frac{4\cdot445}{4\cdot46}\times0\cdot640=0\cdot638$$

$Tan\ \alpha_1 + Tan\ \alpha_2 = 1\cdot79$

$\therefore\ Tan\ \alpha_3 = Tan\ \alpha_1 = \frac{1}{2}\times2\cdot428 = 1\cdot214$

First Stage	Last Stage
8.10 (7.15)	
Root: $u_t = 782 \times 0\cdot7 = 548$ $u_t/V_a = 548/418 = 1\cdot31$ $Tan\ \alpha_3 = 1\cdot034$ $Tan\ \alpha_2 + Tan\ \alpha_3 = u_t/V_a$ $Tan\ \alpha_2 = 1\cdot31 - 1\cdot034 = 0\cdot276$ $Tan\ \alpha_1 - Tan\ \alpha_2 = (u_m/u_t)\,(Tan\ \alpha_1 - Tan\ \alpha_2)_m$ $= (0\cdot85/0\cdot7) \times 0\cdot4515 = 0\cdot5475$ $Tan\ \alpha_1 = 0\cdot5475 + 0\cdot276 = 0\cdot8235$ $\alpha_1 = 39\cdot45 \quad \alpha_2 = 15\cdot4$ $\epsilon = 24\cdot05$	Root: $u_t = 750 \times 21\cdot60/22\cdot60 = 717$ $u_t/V_a = 717/419 = 1\cdot71$ $Tan\ \alpha_3 = 1\cdot214$ $Tan\ \alpha_2 + Tan\ \alpha_3 = u_t/V_a$ $Tan\ \alpha_2 = 1\cdot71 - 1\cdot214 = 0\cdot496$ $Tan\ \alpha_1 - Tan\ \alpha_2 = (750/717) \times 0\cdot638 = 0\cdot6675$ $Tan\ \alpha_1 = 0\cdot6675 + 0\cdot496 = 1\cdot1635$ $\alpha_1 = 49\cdot35 \quad \alpha_2 = 26\cdot4$ $\epsilon = 22\cdot95$
8.11 (7.16)	
$a = 21\cdot5 \quad b = 8\cdot05$ $c = 56 \quad d = 12\cdot55 \quad e = 0\cdot385$ $\theta = 21\cdot5\sqrt{24\cdot05 - 8\cdot05} - 56$ $= 86 - 56 = 30$ $i = 12\cdot55 - 0\cdot385 \times 30$ $= 12\cdot55 - 11\cdot55 = 1\cdot0$ $\beta_1 = 39\cdot45 - 1\cdot0 = 38\cdot45$ $\beta_2 = 38\cdot45 - 30 = 8\cdot45$ $\delta = 15\cdot4 - 8\cdot45 = 6\cdot95$ check: $\delta = 0\cdot26 \times 30\sqrt{0\cdot7} = 7\cdot02$	$a = 23\cdot6, \quad b = 5\cdot0, \quad c = 72\cdot6,$ $d = 12\cdot6, \quad e = 0\cdot41$ $\theta = 23\cdot6\sqrt{22\cdot95 - 5\cdot0} - 72\cdot6$ $= 100 - 72\cdot6 = 27\cdot4$ $i = 12\cdot6 - 0\cdot41 \times 27\cdot4$ $= 12\cdot6 - 11\cdot2 = 1\cdot4$ $\beta_1 = 49\cdot35 - 1\cdot4 = 47\cdot95$ $\beta_2 = 47\cdot95 - 27\cdot4 = 20\cdot55$ $\delta = 26\cdot4 - 20\cdot55 = 5\cdot85$ *check:* $\delta = 0\cdot26 \times 27\cdot4\sqrt{0\cdot7} = 5\cdot96$
8.12 (7.18)	
$\phi = 0\cdot756$	$\phi = \left(0\cdot60 - \frac{1}{10} \times \frac{21\cdot60}{23\cdot60}\right)\frac{0\cdot07}{0\cdot13} + \left(0\cdot40 + \frac{1}{10} \times \frac{21\cdot83}{23\cdot83}\right)$ $= 0\cdot5085 \times 0\cdot07/0\cdot13 + 0\cdot4915 = 0\cdot766$
8.13 (7.19)	
$f_c = 0\cdot968 \times 0\cdot756 \times \frac{3\cdot57}{20\cdot06} \times 6\cdot65^2 = 5\cdot78$	$f_c = 0\cdot968 \times 0\cdot766 \times \frac{1}{22\cdot60} \times 7\cdot5^2 = 1\cdot85$
8.14 (7.20) Steel blades	
$F_f = 30,\ F_e = 58,\ n = 5.\ (S\ 80)$ $f_b = \frac{30\,(1 - 5\cdot78/58)}{5 + 30/58} = 4\cdot90$	$f_b = \frac{30\,(1 - 1\cdot85/58)}{5 + 30/58} = 5\cdot26$
8.15 (7.21)	
$a = 0\cdot157 + \frac{0\cdot186}{1\cdot31 - 0\cdot257} = 0\cdot334$ $b = 1\cdot2 - 30/175 = 1\cdot0285$ $\sigma = 19\cdot6 \times 14\cdot2/288 = 0\cdot966$ $k\Delta T_1 = 2\cdot785, \quad k = 0\cdot2415, \quad \Delta T_1 = 11\cdot53$	$a = 0\cdot157 + \frac{0\cdot186}{1\cdot71 - 0\cdot257} = 0\cdot285$ $b = 1\cdot2 - 27\cdot4/175 = 1\cdot0435$ $k\Delta T_2 = 4\cdot445,\ k = 0\cdot2415,\ \Delta T = 19\cdot2$ $\sigma = \frac{19\cdot6 \times 71\,(1 - 18\cdot4/481)^{2\cdot186}}{464} = 2\cdot66$
8.16 (7.22)	
$c_l^2 = \frac{0\cdot0414 \times 0\cdot334 \times 1\cdot0285 \times 0\cdot966 \times 3\cdot54^2 \times 11\cdot53}{4\cdot90}$ $= 0\cdot447, \quad \therefore c_l = 0\cdot668$	$c_l^2 = \frac{0\cdot0414 \times 0\cdot285 \times 1\cdot0435 \times 2\cdot66 \times 1^2 \times 18\cdot4}{5\cdot26}$ $= 1\cdot135 \quad \therefore c_l = 1\cdot065$
8.17 (7.23)	
$\zeta = \frac{1}{2}\,(38\cdot45 + 8\cdot45) = 23\cdot45$ $Cos\ \zeta = 0\cdot9172$ $w_s = 0\cdot9172 \times 0\cdot668 \times 2^2/_3 = 1\cdot63$	$\zeta = \frac{1}{2}(48\cdot0 + 20\cdot6) = 34\cdot3$ $Cos\ \zeta = 0\cdot826$ $w_s = 0\cdot826 \times 1\cdot065 \times 2^2/_3 = 2\cdot35$
8.18 (7.24)	
$L = 15 \times \frac{1}{2} \times 3\cdot98 = 29\cdot9$ in.	

To be continued.

Research and Power Reactors in Canada—IV

—a review of progress

By J. R. FINNIECOME, M.Eng., M.I.C.E., M.I.Mech.E., F.Inst.F., Consulting Engineer

13. The properties of organic liquid coolants

The polyphenyl hydro carbons, such as diphnyl and the terphenyls are the most stable commercial materials for organic liquid coolants. The desirable properties are:

(a) thermal and radiation stability
(b) low melting point (near room temperature)
(c) low viscocity
(d) low vapour pressure
(e) low cost
(f) easily available in large quantities

The composition and the essential properties, including the cost of five organic liquid coolants, are summarized in Table VII. As stated in the previous paragraph "Santowax OM" has been given preference for "OCDRE" and "OCDR" reactors.

14. Production and value of uranium ore (U_3O_8)

The Eldorado Mining and Refining Limited, a Crown Corporation, was formed in Canada in 1944 with the purpose of mining and refining uranium ore and also purchasing uranium concentrates from private producers in Canada. In 1955 the Rio Tinto Mining Company started mining in Canada to develop the world's largest uranium resources, in Ontario. To-day Rio Tinto manages four mining companies holding contracts worth more than £130 million for the delivery of about 30 million lb of uranium concentrates during the six years and to achieve the most economic production the four have been amalgamated into one—Rio Algom Mines Limited. The Rio Tinto Mining Company of Australia has a 51% interest in the Mary Kathleen Uranium Mine, the largest in that country.

The production of uranium oxide (U_3O_8) and the reserves for the principal countries for the years 1959, 1958 and 1957, expressed in short tons are shown in Table VIII.

In 1959 uranium accounted for 6·2% of the total of Canadian exports.

By the end of 1958 Canada's uranium mining industry had in operation a total of 21 mines and 19 mills with a capacity in excess of 42,150 ton of ore a day. There were also 17 processing plants. A summary of the output and value of the production of uranium oxide (U_3O_8) in Canada for the years 1954-58 is presented in Table IX, which also gives totals in columns 8 and 9.

15. Production of thorium

A thorium extraction plant has been operating in conjunction with a processing plant for uranium at Elliot Lake. It is owned by Rio Tinto Dow Limited, and the recovery was about $\frac{1}{2}$ lb of thorium for each pound of uranium produced. About 150 ton of thorium salts and crude thorium concentrates, refined metallurgical grade thorium and thorium oxide are produced annually by the solvent extraction method. The plant was built by Humphreys & Glasgow (Canada) Limited.

Thorium (Th) with an atomic number of 90 and an atomic weight of 232 is not a nuclear fuel. However, when it captures a neutron it undergoes a transformation and is finally converted into U233 which has similar properties of U235. Therefore by mixing U235 or plutonium, Pu239, with thorium, Th232, it is possible to utilize the latter as a nuclear fuel.

16. Reprocessing of irradiated fuel

Atomic Energy of Canada Limited has arranged for reprocessing to be done at the U.S. plant at Savannah. This applies particularly to the fuel of the research reactors NRX and NRU at Chalk River. The 11 ft. long fuel elements are transported by rail in specially constructed casks, designed with integral cooling to remove the decay during transit. The specific requirements of these casks are that the fuel elements and the cladding should not melt even if all cooling water is lost from the cask. The irradiated fuel is passed to the chemical separation plant from which the by-product plutonium, Pu239, is extracted.

17. Heavy water

Heavy water, known as deuterium and having the chemical symbol D_2O, has the most important feature that it has twice as many hydrogen atoms as ordinary water, the atomic weights being 20·03 and 18·016 respectively. Heavy water has a special role as a moderator for nuclear reactors, particularly those using natural uranium as fuel. The primary advantages are:

(a) It is more effective and efficient than graphite or light water, for it absorbs 500 times fewer neutrons in a reactor than light water.
(b) It assists in the control and stabilization of the reactor.
(c) The draining out of the heavy water will shut down the reactor.
(d) The output of the reactor is controlled by varying the level of the heavy water.

The purchase price is of crucial importance for it amounts to about $28 (£10) per lb. In the case of the

Table VIII.—RESERVES AND PRODUCTION OF URANIUM OXIDE (SHORT TONS)

	Reserves	1959	1958	1957
(a) Canada	413 000	15 909	14 118	6 635
(b) United States	221 000	16 390	12 560	10 000
(c) South Africa	330 000	6 200	6 245	5 700
(d) Belgian Congo	10 000	—	1 000	—
(e) France	50 000	—	815	—
(f) Australia	15 000	1 000	840	500

Table IX.—PRODUCTION AND VALUE OF URANIUM OXIDE IN CANADA FOR THE YEARS 1954 TO 1958

1	2	3	4	5	6	7	8	9
	Ontario		Saskatchewan		Alberta		Canada	
Year	Quantity lb	Value dollars	Quantity lb	Value dollars	Quantity lb	Value dollars	Quantity lb	Value dollars
1954	—	—	—	10 981 417	—	15 486 157	—	26 467 574
1955	—	487 054	—	12 312 471	—	13 232 079	—	26 031 604
1956	906 100	9 361 867	2 780 534	27 194 202	813 912	9 176 076	4 560 546	45 732 145
1957	7 970 598	82 940 763	4 462 552	44 561 832	838 264	8 801 769	13 271 414	136 304 364
1958	21 403 832	221 895 356	5 865 500	58 705 000	964 000	9 628 000	28 233 332	290 228 356

Candu reactor the total quantity is 180 tons for a thermal rating of 698 MW (th) and a net electrical output of 203 MW (e). On the basis of these values, the heavy water for moderator and coolant corresponds to 0·2578 ton per MW (th) and 0·8867 ton per MW (e). Therefore it follows that the total cost of the heavy water is about £403 million.

The amount of heavy water contained in natural water varies slightly, depending on the source of the water, but the average is one part in 6500 or 0·0154% of deuterium oxide. A comparison of the physical properties of heavy and light water is indicated in the accompanying Table X.

18. Methods of producing heavy water

Briefly, the principal processes are:

(a) electrolysis
(b) distillation
(c) distillation of hydrogen
(d) catalytic exchange between hydrogen and water vapour
(e) combined electrolysis of water and steam-hydrogen chemical exchange
(f) dual temperature—hydrogen sulphate (H_2S) exchange between steam and hydrogen at two temperatures
(g) a combination of ammonia—hydrogen exchange and ammonia distillation

18.1. Electrolysis

Electrolysis is a chemical change or decomposition produced by electric energy. It is economically possible only if cheap electric power is available. The atomic structure of hydrogen is the simplest possible, consisting of a nucleus or proton with one electron.

When water is electrolysed there is a concentration of deuterium in the water. By operating a countercurrent principle, a concentration of deuterium can be achieved. Until 1943 all the heavy water was produced commercially by electrolysis and the largest single producer was the Norsk Hydro Company which operated the largest electrolytic hydrogen plant at Rjuken in central Norway, 100 miles north-west of Oslo. This factory had been manufacturing heavy water since 1934, two years after the discovery of deuterium by the American, H. C. Urey and his collaborators in 1932, as the result of fractional evaporation of liquid hydrogen. The primary plant at Rjuken produced water containing 15% deuterium. This was then refined in a secondary plant. In 1942 this factory was making about 1·7 tonne of heavy water a year as a by-product of the production of 640,000 cu ft (NTP) per hr of electrolytic hydrogen, used for ammonia synthesis. The average power consumption was 91,000 kW.

18.2. Distillation of water

As there is a small difference in vapour pressure between H_2O and HDO, separation may be achieved by fractional distillation. This method was applied by E. I. du Pont de Nemours Company at the three U.S. ordnance factories at Morgantown, W. Virginia, Childersburg, Alabama and Wabash, near Newport, Indiana, planned in 1943 to produce heavy water for the Manhattan project. All three plants were in production in 1944, i.e. within a year. Distillation offered the quickest method of getting into production. The output was 1·2 ton per month in 1944. The distillation towers were heated by high pressure steam though low pressure steam bled from the turbine of the generating plant would have proved more economical. Compared with other methods of producing heavy water the total investment charges and the operating costs are very much higher.

Table X.—PHYSICAL PROPERTIES OF WATER

		Heavy water	Light water
(a) Chemical formula		D_2O	H_20
(b) Molecular weight		20·03	18·016
(c) Density at 15°C	kg/dm³	1·1077	1·00
(d) Specific heat at 15°C	kcal/kg/°C	1·01	1·00
(e) Boiling point	°C	101·4	100
(f) Freezing point	°C	+3·79	0
(g) Temperature at maximum density	°C	11·2	3·98
(h) Critical temperature	°C	371·5	374·2
(i) Critical pressure	at.	218·6	218·5

18.3. Distillation of hydrogen

At the normal boiling point of hydrogen there is a marked difference in the vapour pressures between H_2 and HD. As these materials form a perfect solution, it is possible to separate them by fractional distillation. This process was seriously considered in 1943. In collaboration with H. C. Urey the E. I. du Pont de Nemours Company, Inc. prepared preliminary designs and estimates for such a plant. Only design studies were made and pilot plants constructed.

18.4. Catalytic exchange

It has been found that when a mixture of H_2, HD and water vapour is passed over a platinum or nickel catalyst the deuterium transfers from HD to HDO. The latter is then absorbed in water and by operating a series of countercurrent towers with electrolysis of the water between the towers the deuterium can be concentrated. The Consolidated Mining and Smelting Company of Canada Limited (COMINCO) factory at Trail, British Columbia, was the first installation on the North American Continent and the second in the world. In 1945 the average hydrogen production rate was 520,000 cu ft (NTP) per hr producing 0·55 ton per month of 99·8% D_2O. The electrolytic process was also used at Trail, but only to refine crude heavy water which contained 2·14% D_2O.

18.5. Combined electrolysis of water and steam-hydrogen

In 1941 the steam-hydrogen exchange process for enriching deuterium was proposed independently by H. C. Urey and his collaborators in the United States and Harteck and co-workers in Germany. In the electrolytic cascade 67·3% of deuterium in the water feed leaves with the hydrogen product at too low a concentration. Some of the deuterium in the hydrogen can be recovered economically by the steam-exchange process.

18.6. Dual-temperature water-hydrogen sulfide exchange

This process was considered for the Manhattan project in 1943. At that time it was not proposed to build such a plant for the production of heavy water. The basic principle was disclosed in a United States patent 2,787,526 (J. S. Spevack, assignor to the U.S. Atomic Energy Commission). The process, combined with vacuum distillation and electrolysis, is now being used in the heavy water production plants of the U.S.A.E.C. at Savannah River, South Carolina and Dana, Indiana. These have been in operation since 1952 and 1957 respectively.

18.7. Ammonia-hydrogen exchange and ammonia distillation

This process was applied to an experimental plant designed by Constructors John Brown Limited in 1958. The system has the advantage that it can be operated economically on a relatively small scale, for instance, as an ancillary to the production of synthetic ammonia. As the heavy water is a by-product it is of reasonably low cost.

To be continued

UP CUT SHEAR.—This up-cut shearing machine made by The Bronx Engineering Company Limited, Stourbridge, will form part of a coil cut-up line. It can deal with mild steel plate up to ½ in. thick and 6 ft. wide and operates at 120 strokes per minute. Shearing action is from below, and the hold down, also operated from below, is actuated by two air cylinders. The machine has an electro-magnetic clutch and brake

Process Controller

A new device for controlling the amount of electrical energy put into an industrial process has been developed by The English Electric Company Limited. It will dispense a predetermined amount of electrical energy for mixing processes (e.g. in bread, confectionery, plastics, rubber, chemicals) and in heat processes for metals, plastics and liquids, and gives the precise control necessary for successful automation. It takes into account variations in the electric supply and changes in the nature of the material which occur as the process progresses, both of which affect the time needed for completion. When the required amount of energy has been dispensed the process is automatically stopped.

Basically the controller consists of a two element watthour meter together with an additional disc, a lamp and a photo-electric transistor. Light from the lamp passes through holes in the disc on to the light-sensitive surface of the transistor. The disc rotates at a speed depending upon the electrical energy being put into the process and thus acts as a variable shutter between the lamp and transistor. Pulses of current, emitted from the transistor, energize a transmitting relay, which in turn impulses a separately mounted counter. The counter is adjustable by hand so that the prescribed number of watthours for a process can be selected. As the counter us repeatedly energized the wheels rotate to count down to zero. At zero a change-over switch operates to interrupt any further incoming pulses and energizes a tripping relay, which stops the process.

Steel Cord Conveyor Belt

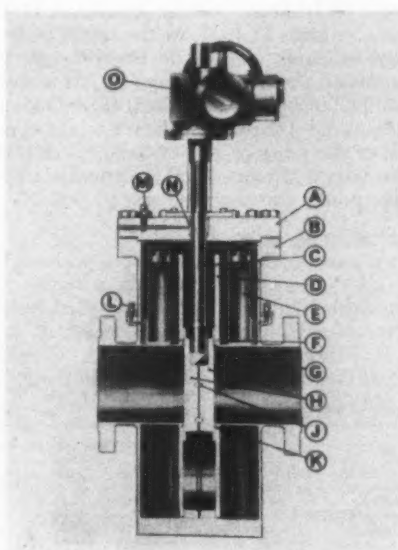
A new concept in conveyor belt construction, having no fabric of any type whatsoever is being produced by Barrow Hepburn & Gale Limited, Church Road, Mitcham, Surrey. Steel cords placed in the warp direction provide the great strength of this belt. They are surrounded by layers of rubber providing a weft strength of over 3,000 lb/in. for an average thickness belt, and a tough long lasting wearing surface. The belt can be supplied in any width from 30 in. up to 118 in. in varying thicknesses from 14 mm upwards according to the duty required. Very long single flight hauls are possible with resultant savings in installation, power and labour costs. The belt is extremely flexible and can run on 45° troughed idlers allowing up to 30% more load to be carried for a given belt width.

Fabricated Valve with Plastic Seal

A new type of pipeline valve which has the McEvoy automatic self-sealing system embodied in a simplified and wholly fabricated body so that it is fully competitive with pipeline valves employing conventional sealing methods, has been introduced by the Newman Hender Group of Woodchester, Stroud, Glos.

The cylindrical body and pipe ends are rolled steel plate. The seat and gate members, flanges, bonnet and valve base are also made from similar material. A thick steel stiffening rib is welded on each side of the body in line with the ports. The only major precision machining operations necessary on the valve are one face each of the seat and gate plates, the stem and gland surfaces and the sealing compound reservoirs.

The principle of the sealing system is that a compound, fed from reservoirs built into the valve, fills sealing grooves in the seats on each side of the valve. Sealing compound is held in reservoir E, topped by a free-floating piston, and is fed via channel F to the sealing groove K in the seat face. A jumper groove G in the gate face completes the circuit between the reservoir and the sealing groove only when the gate is in the closed position shown. This prevents unnecessary loss of sealing compound from the reservoir when the valve is open. The reservoir is replenished from time to time through the pressure-gun point L. The two halves of the gate H are spring-loaded against the seats by a series of springs J. The gate surfaces are therefore in continuous wiping contact with the seats. The automatic self-sealing feature of the system relies upon the fact that any loss of sealing compound from the seat sealing groove, due to turbulent line flow, sets up unbalanced pressure in the downstream sealing circuit, when pressure on the piston in compound reservoir E is greater than the pressure in the sealing groove itself. This forces sealing compound from the reservoir into the sealing groove until a balance is reached.



The McEvoy plastic sealing in this new Newman, Hender valve ensures automatic tightness under line pressure

High Pressure Boiler Gauge

A new level indicating gauge for pressures up to 2,500 psi is announced by Richard Klinger Limited, Sidcup, Kent. Called the Klinger Port Hole Gauge, it employs the difference of refractive indices of steam and water for illumination of the glass. The visual ray passes straight through the steam space on to an illuminated red screen but is bent in the water space on to an illuminated green screen. As the gauge centre piece is wedge shaped the visual rays strikes the steam and water space at an angle, thus causing refraction, and an image of red steam and green water is produced. To withstand the thermal stresses created at high pressures, separate round glasses of controlled dimension and material are used. These glasses are not subjected to the high clamping loads of the cover bolts, but are free to expand and contract in the cover recesses and are protected by twin micas of special quality.

For screen illumination 15 watt pigmy bulbs are used, but should a single bulb fail the gauge will still provide a clear and level reading. This level can be transmitted from the boiler face to the control station by a simple periscope arrangement of mirrors.

The gauge can be built in many lengths to suit requirements by varying the centre piece and adding standard covered components. The gauge can be used economically for steam pressures from as low as 400 up to 2,500 psi.

Compact Steam Generator

The Wanson Company Limited is now manufacturing a new type of package steam generator at its Borehamwood, Herts., factory. The Vaporax, as it is called, has previously been manufactured and distributed on the Continent only from the Wanson factory in Belgium. Two models are being produced: the 100 and 300, with maximum steam outputs of 220 and 660 lb per hr respectively, at pressures ranging from 40 to 110 psig.

A feed tank incorporated in the unit is kept full of water by a flow valve. Water is forced by a multi-stage boiler feed pump into a tubular coil in which it is vaporized by heat developed in the centre of the coil by the combustion of fuel. Steam coming from the coil at high velocity enters a water separator and is available at the main valve at a dryness fraction of 0·98. The water separated is returned to the feed tank through a steam trap and is thus reduced to atmospheric pressure.

Control and safety devices include spring loaded pressure release safety valve, shut-off valve and blow-down cock, all of accepted construction conforming to BS.756. Safety of burner operation is ensured by photo-resistor flame failure equipment, conforming with BS.799. A diaphragm balanced pressure switch shuts the oil burner down as soon as the water ceases to flow.

Expanding Grout

The grout used to support a machine on its foundation is usually made from cement, sand and water, a mixture which may shrink on setting. A grout with the opposite characteristic—one which expands on setting—is well known in America and has recently been introduced on the British market by Millar's Machinery Company Limited, Thorley Works, Bishop's Stortford, Herts. Known as "Embeco", it consists of cement, sand, and

STORAGE RACKS.—The new Acrow Series 75 storage rack is built up of members which simply slot together. The locks are cold formed from the material itself and there are no third-piece connectors, so the erection of a rack is accomplished in a matter of minutes. The uprights are sway-braced at the factory. Each rack is adjustable on 3 in. centres from top to bottom.—Acrow (Engineers) Limited, South Wharf, London W2

a catalyzed metallic aggregate containing a water reducing and other agents. On placing, initial shrinkage during the first three hours is followed by expansion until all air pockets are filled. Compressive strength after 24 hr is 4 000 psi, and 10 000 psi after 28 days.

Co-Axial Gearbox

A new co-axial gearbox introduced by Higgs Motors Limited, Witton, Birmingham 6, is suitable for any type of input or output drive and either shaft is suitable for being driven through a foot mounted motor, internal combustion engine or any other prime mover by means of a coupling, belt or chain. The high-speed shaft will accept or provide speeds up to a maximum of 1500 rpm, and a choice of standard fixed ratios ranging from 3:1 to 50:1 with horsepowers up to 7½ is available.

The body is cast in one piece and designed to eliminate oil leakage. Deep circular spigots and oil seals ensure that the unit as a whole is oil-tight. Filling, oil-level, and drain plugs are standard. The gears are generated and bearings, shafts and gears are designed with a high safety factor.

The gearboxes are suitable for horizontal mounting, left and right-hand side mounting, or inclined mounting.

PVC Machine Guards

Recognizing that machine guards must not unduly restrict the movements of the operator or impair his vision. Minderguards Limited of Long Ashton, Bristol have developed a new type made from transparent semi-flexible Vybak sheets supplied by Bakelite Limited. The guard fully complies with the requirements of the Factories' Act. The new guards can be tailored to fit all types of machine, are "one-hand" operated and limit switch controlled, providing separate inching arrangements. All moving parts of the machine remain in view with the guards in use, and adjustments can easily be made without removing the protective screen. When desired, a machine can be stripped of guards in a matter of minutes. Complete sets can be fitted to a new machine in a few hours, and arrangements can be made for over-night fitting to avoid loss of production. The clear-vision Vybak gates have good impact strength, are virtually shatter proof and fire resistant. Each of the gates is electrically controlled by limit switches.

Production Practice:

Finned Arbors for Large Diameter Bores
Small Toggle Press
V-Belt Adjustment
Spotfacing in Awkward Corners

By JOHN WALLER

THE grinding of large diameter work (reducing the outside diameter of standard tubular details is a typical example) requires the use of a specially made mandrel often much heavier than the component fitted to it, consequently in addition to the excessive weight on the front bearings of the machine, there is also the difficulty of loading the assembly between the centres and the task is frequently much more awkward than is really necessary. A reduction in the weight of these grinding arbors is thus useful, and though milling or drilling pockets both axially or crosswise through them does reduce the amount of material and so saves a few pounds of handling weight, the final assembly loaded on to the grinding machine by an operator is still excessive and leads to fatigue.

The use of finned arbors, while not always suitable, does reduce the weight of an arbor to a minimum and Fig. 1 illustrates a mandrel of this design which utilizes the four-spider principle. The end elevation clearly indicates the saving achieved and the cost of making it is less than the orthodox design with drillings.

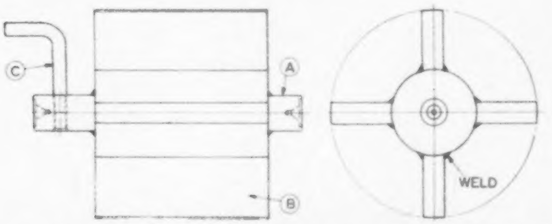


Fig. 1.—Finned mandrels while not applicable to every large component, are useful on a rotary grinding machine because they make handling so much simpler. They also provide a use for old solid mandrels

Each fin is welded to a centre core mandrel and the number required will depend on the design and size of the workpiece to be ground or turned. Generally four will prove adequate though on occasions six spaced equally are essential, especially if the walls of the component are thin and thus likely to allow chatter marks to appear on the finished surfaces. Each mandrel is finally ground slightly taper in the normal way and a small lead on the front end is useful to facilitate loading. The provision of a driving pin is optional but is preferable to using a heavy and cumbersome carrier as this tends to defeat the object of the mandrel.

A further application occurs with old solid mandrels —those above 1 in. to perhaps $2\frac{1}{2}$ in. dia and which are badly scored through coming into contact with the grinding wheel or tool—which are salvable by this method, and the larger sizes are ideal for finned mandrels in the region of 6 in. dia. In such cases some attention to the centres is usually essential because they become worn or scored and require renovation in the shape of a coned grinding wheel being gently applied until the surface again resumes a perfect female cone. Care is obviously necessary with this operation because most mandrels are simply casehardened and the removal of too much metal means that the finished cone is in the soft condition and thus unsuitable for rotating between centres. In bad cases a preliminary heat treatment to restore the hardness is required, but this still does not make the final cost excessive. Fins are then welded to the mandrel and the outside diameter is ground to size.

While this type of mandrel has been designed and is used primarily for grinding and other machine work, they also find a ready place in the inspection department as light weight makes the handling of castings and forgings easy and can, in some instances, eliminate the use of lifting tackle when the components require turning over.

The massiveness of the usual mandrel press is sometimes a disadvantage when small parts are being handled, and a lighter machine giving a clearer view of the work yet still able to exert enough pressure is advantageous. A small toggle press is easily made up from pieces of steel plate and provided it is only used for small parts it will prove a valuable asset to the machine shop. Such a press is particularly useful for assembly purposes where an occasional hole is necessary through thin sheet material, or perhaps some portion of a component requires notching out.

The base A (Fig. 2) is a fabricated steel framework

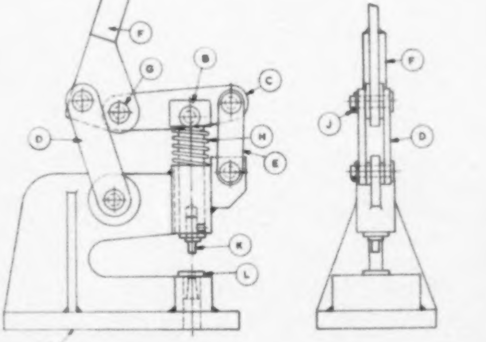


Fig. 2.—A small toggle press built-up from strip material with a fabricated base is useful for light assembly work, piercing odd holes in sheet metal or cardboard and eyelet clinching

with the base drilled for holding down bolts. Two webs on the vertical frame are to prevent twist. The ram B slides in a hole bored in the frame and though a bush here is an advantage, the machine will operate continuously for a long period before it becomes necessary to provide one.

Bright mild steel strip is used for links C, D and F and pins G. No hardening was used on the original machine for these parts as silver steel was considered adequate. The handle was built up from the same strip and its length of some 12 in. restricts leverage to reasonable proportions.

A fairly strong spring is needed to lift the ram every time a stroke is completed, and a heavy gauge wire in the region of 0·09 in. makes sure that too much upward pressure is not imparted to the handle.

The ram is turned with the head and shank integral and the former is slotted to receive the cross bar C. As there is a rocking action the bottom of the slot is given a curve to ensure clearance when the ram descends, while the depth of the slot is sufficient to give adequate support to the bar and this again prevents twisting.

Because only simple tools are used quick dismantling is essential and the die is merely a sliding fit in the base. The dies are hardened in the conventional manner, and an angular relief behind the cutting edge enables the slugs to fall away. A small grub screw is sufficient to hold a punch in the ram and there is no need to provide location when circular holes are punched. However, piercing square holes is possible if a location is incorporated and the usual slots machined across the face of the base into which the die can drop—two flats are, of course milled and ground on the hardened die to correspond to the slot width, and a similar arrangement in the face of the ram will ensure that both are aligned correctly.

An operation ideally suitable for this kind of machine tool is the clinching of hollow eyelets which have previously pushed through a thick fabric, because the flimsy nature of the work makes it difficult to handle quickly on a power machine. The variation in the material also means that a fixed stroke makes it difficult to clinch over the eyelet tightly when the punch encounters the material surface, but the delicate control on this press overcomes this and the two parts are held together in close contact.

Another use for this press is seen in the cardboard working shop which must perhaps punch thick board in small quantities at intervals and where the cost does not justify the installation of an elaborate machine. In this case the face of the punch is preferably dished to assist cutting by providing a shear, then there is less risk of raising a burr on the punched board. For punching a hole through the bench top for the slugs to drop through is essential, also a tray underneath to prevent litter.

Space restrictions often make an adjustment to a V-belt a difficult operation and many elaborate ideas are employed in order to effect a slight tightening of the belt, and when such work only occurs once or twice during the life of a machine the provision of perhaps special castings coupled with the cost of machining them means that belt adjustment is a relative costly process.

Most V-belts need only a minute amount of retraction —a few thousandths of an inch can achieve a remarkable difference in the driving characteristics of a machine, so the universal use of slideways is not always necessary as a suitable tensioning is possible by a method similar in principle to that applied in variable speed devices where the belt is "expanded" according to the speed required from the equipment.

The illustration, Fig 3, shows a two-part pulley which consists of a detail A which is attached to the motor or machine spindle by means of a pin D. One end is threaded to suit lock nut C. The second portion of the pulley—the right hand side—can slide on the fixed part though, of course, the degree of movement is small and is only enough to cause the belt to tighten sufficiently, but the action of threading the locknut toward the machine bearing tends to force the belt B outwards and so make for more effective driving. The locknut is afterwards prevented from retracting by locking the small clamping screw.

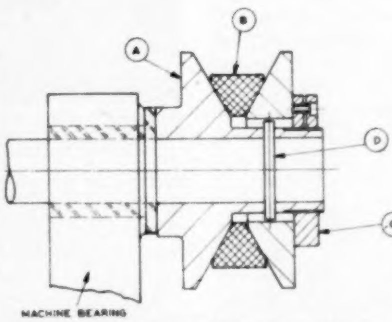


Fig. 3.—If a space is restricted this V-belt tightening device is easy to operate and is precise in action

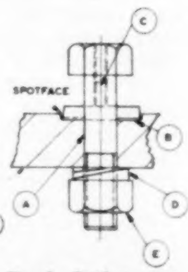


Fig. 4.—Spotface cutter for use when the facing is inaccessible or when the surface is found to be damaged during assembly

There are many occasions in the fitting and assembly shops when it becomes necessary to clean a casting locally to make a seating for a nut or bolt head, or perhaps a facing becomes slightly damaged and requires reseating before the components are finally bolted together, but the weight of such a component coupled with the possibility that too much assembly work has already been performed to make it possible to return the casting to the machine shop, make it necessary to carry out the work on the site with little if any disturbance.

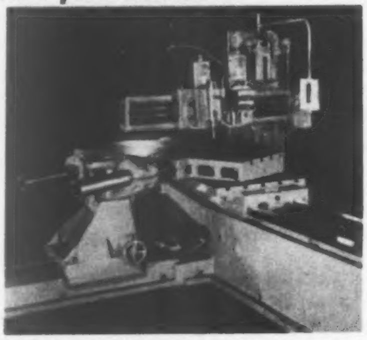
If space permits, a hand operation to clean away burrs or even to make a shallow facing is the solution to this type of problem, and a tool turned with the aid of a spanner will finish the surface though, of course, the time taken is considerably longer than normal machining methods. A steel bolt A (Fig 4) is cross drilled and filed to make a holder for a square section tool—this section is not strictly necessary but it does make the holding of a tool so much easier—and the head is also drilled and tapped for the socket grub screw C. The tool bit B is made from a piece of cast steel and hardened and tempered, but when a sandy surface is encountered either two tools—one to remove the scale while the second finishes the face—are used or an attempt is made to file off most of the scale before the cutter is introduced to the bar. A spring washer D and nut E complete the assembly and the result is a short stiff bar which is ideal for a light skim over a casting or flat steel plate.

The bolt and cutter are placed in position as shown in the drawing and the washer and nut are added, but care is taken to see that the latter is only finger tight and that the bolt can move easily. Next the nut is held with one spanner while another is applied to the bolt head, and used judiciously a good finish is secured without difficulty, but it is essential to remember that the tool is really a stopgap arrangement and in no sense replaces the orthodox method of spot-facing a casting.

Machine Tool Record

Rockford Radius Planer/Grinders

The machine shown in the accompanying illustration was designed to plane and grind radii from 20 in. to 20 ft. With a small change-over it can also be used for standard planing and a side head can be fitted if required. The short upper table is necessary for radius planing only; the main table can be of any length. There is a cam-roller, anti-friction slide mechanism between the upper, or radius table and the standard table. The underside of the radius table has a cross slot which is lined with hardened wear plates. The slide block itself is mounted on the main table employing a threaded and piloted pin which is also mounted in anti-friction bearings.



The Rockford radius planer has long extension beds, the junction of which is seen here where the swivelling table is mounted under the cutter head

The required radius is set by using vernier scales and a checking plug. The latter is first inserted in position, tripping a cut-out switch in the hydraulic motor circuit to prevent accidental table operation. Two scales are employed, one for positioning the pivot slide along its bed, the second being placed in the cross slot in the surface of the radius table. Both are graduated to read zero at the checking plug, thus the sum of the two dimensions equals the radius machined.

The machine is made by Rockford Machine Tool Co. of Rockford, Illinois, U.S.A., for whom sole U.K. selling agents are Rockwell Machine Tool Company Limited, Welsh Harp, Edgeware Road, London N.W.2.

Sit-down Shot Blast Machine

The new Model SBP/41 Sit-Down shotblast machine made by Guyson Industrial Equipment Limited, Otley, is designed especially for the small component and instrument manufacturer who requires to treat many hundreds of delicate instruments or intricate small components during the day. Constructed to give the utmost comfort to the operator, the machine has a specially designed hopper enabling the average man or woman operator to be seated at the machine for full-time shotblasting. This conserves energy and gives a greater output. Also provided are load-in and throw-out chutes on either side of the cabin, two guns controlled by foot-pedals, one for shotblasting and the other giving a quick blast of air to dust off the components after treatment, and a dust extractor and collector unit.

Sit-Down shot blast designed specially for dealing with delicate and intricate components

New Fluid Drive Shears

The range of Fluid-Drive shears was first introduced by Joseph Rhodes & Sons Limited, Grove Ironworks, Wakefield, in 1946-47 and proved immediately successful. A recent model incorporates many advanced refinements. Control is pneumatic, by treadle action; actuation causes one complete stroke, or by a simple adjustment the shearing is governed throughout by treadle action and reversal of the beam takes place immediately upon release of the treadle. In both circumstances the length of the stroke never exceeds the length of cut; this feature eliminates wasted time in making cuts of superfluous length. If the machine is inadvertently overloaded an automatic release returns the beam to the top of stroke position preventing undue stress or strain occurring in the machine.

A two-speed hydraulic drive gives a nominal speed of 7 strokes per min on material 1 in. thick and this is increased to 19 strokes per min when shearing light material up to $\frac{3}{8}$ in. thick. Another feature is the automatic return of the beam to the commencing position at a rate much increased over the down stroke. The machine illustrated has a blade length of 8 ft. 2 in. and blade taper of $\frac{3}{8}$ in. per ft. For shearing lighter material the taper is adjustable down to $\frac{1}{4}$ in. per ft. This permits further increased operating speed and reduces twist on narrow strips. Adjustment of blade clearance is effected with accuracy in a matter of minutes. The material is gripped firmly by hydraulic hold downs before shearing commences.

Eight-foot Fluid Drive shear with electro-hydraulic actuation and pneumatic treadle control

Forming Resinoid Pipes

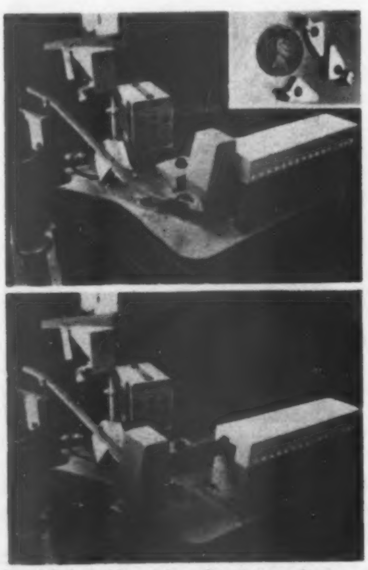
A special forming head fitted to their standard screwing machine by Joshua Heap & Co. Limited, Ashton-under-Lyne, is specially designed for forming and facing the ends of resinoid bonded pipes used in the chemical industry. The head is operated by an axially mounted hydro-pneumatic cylinder which forces the tool boxes to plunge from the outside of the pipe and also the end face. The method has greatly reduced the production time on these components. The pipes are gripped in the self-centring vice and can be quickly brought up against a stop in one of the tool boxes in the special head. The saddle is then clamped on to the bed and the forming operation

Special head fitted to Heap screwing machine for plunge forming the ends of resinoid pipes

commenced; this takes less than a minute. The present machine is capable of forming pipes 1 ft 6 in. dia. A second machine is being made for the same customer to cater for pipes up to 14 in. diameter.

Automatic Transfer Unit

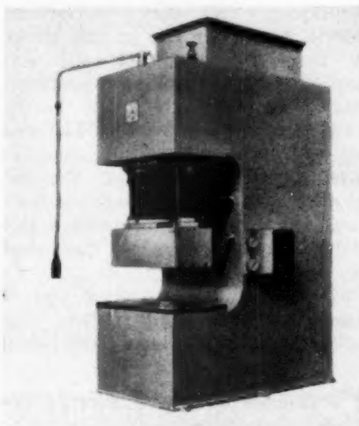
The "TransfeRobot 200" is a versatile new device already in use in the manufacture of such varied products as clocks, business machines, razors and automotive and electrical equipment. Created by Mr. E. F. Shelley, vice-president of U. S. Industries, Inc., 1/5 New Bond Street, London W1, the machine uses its fingers to seize, move, position and relinquish the work piece it is handling. With the use of an accessory swivel, the machine aquires a "wrist" which enables it to perform virtually any required set of motions within the limits of its reach.



TransfeRobot picks up (top picture) typewriter component (inset) from chute and transfers it (bottom picture) into nest of auto countersinker

Upon command of its electronic control the machine performs its own tasks and orders other machines (including other TransfeRobots) to act as well. It is thus in constant communication with the rest of the production line.

If the control informs it that something has gone wrong in the work programme, the machine stops and the supervisor is informed by flashing lights or buzzers.



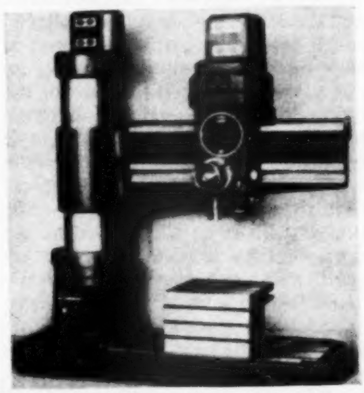
Self-contained 300-ton press with duplicated controls

300-Ton Press

The 300 ton down stroking Prestige hydraulic gap press illustrated is completely self contained, the pumping unit, valves, piping and other equipment being housed within the press frame. Control is by electrical push button, and by means of a selector switch, single cycle operation, inching and single stroking can be effected. The controls are duplicated so that the unit can be operated from the side of the press or from the movable pendant. The rams are hard chromed and the electrics are wired in Pyrotenax. For light pressing, the main ram can be taken out of circuit and loads up to 40 ton achieved by the side rams. Electrical limits control the stroking and these can be adjusted to suit the job being processed. An adjustable calibrated relief valve is included in order that any pressures can be pre-set. The frame is of heavy welded construction. The maximum deflexion registered on the centre line of ram at 300 ton was 0·009 in. The press, which is one of a range manufactured by William Jones Limited, Westmoor Street, Charlton, London SE7, is powered by a 25 hp Towler Bros. pumping unit delivering hydraulic oil at a maximum working pressure of 2 ton per sq. in.

Radial Drills

B.W.F. radial pre-select drilling machines have hydraulic pre-selection of feeds and speeds, high power for maximum penetrating capacity, centralized control of arm elevation and hydraulic clamping. The machine is made in standard types and travelling column models. Control is centralized and an electro-hydraulic system locks arm and column as one rigid unit. Standard machines have from 4 ft 2 in. to 11 ft 4 in. drilling radius. The movable column machines are suitable for boiler drums and other long and bulky work.—William Watts Limited, Canal Street, Nottingham.



B.W.F. radial drilling machine model BR 1250 × 4

Oil from Swarf.—A new centrifuge by R. Cruickshank Limited, Birmingham, separates cutting oil from swarf and processing and tempering oils from components. The oil is then ready for immediate re-use. The removal of surplus oil is followed by a blast of hot air through the spinning basket to maximize oil reclamation.

Generating vibration.—A very low frequency vibration generator has been developed for testing purposes by Fairey Air Survey's Research and Engineering Division, White Waltham, Maidenhead, has a 2 000 lb thrust with a working range of 0-50 cycles per sec and a maximum stroke of 4 in.

Bar Cropper.—Scottish Machine Tool Corporation Limited, Glasgow C3, have recently completed a machine for cropping mild steel bars up to 4 in. square and flats up to 8 × 2 in. It is of closed-frame fabricated construction and embodies an air friction clutch to transmit the drive.

Crankshaft Lathe.—Dunbar & Cook Limited, Birmingham 6, have added the "crankmaster" crankshaft lathe to their range of machine tools.

technique

—devoted to the discussion of practical problems
Readers are invited to contribute items from their own experience in matters relating to design, manufacture and maintenance

Rolling Ultra Thin Foil

Rolling thin material has presented many problems due to distortion of the rolls used in manufacture, but this has been overcome in Rohn and Sendzimir type mills by the use of pyramidal systems of back-up rolls supporting the work rolls over their whole length.

In the thin foil Sendzimir mill this principle is applied so that there are two work rolls about $\frac{1}{4}$ in. dia made of die steel or other suitable material which are supported by two pairs of back-up rolls nominally about $\frac{1}{2}$ in. dia symmetrically disposed to the work rolls. Each pair of back-up rolls is supported on a further group of three back-up rolls which are synchronously driven by the mill motor through gearing and coupling shafts. Finally these rolls are supported by four outer stationary shafts along the lengths of which are distributed a number of roller bearings equally spaced from each other and supported by intervening saddles which transmit the roll load to the inside face of the cylindrical housing.

The housing is bored from a solid forged steel block, the front being closed by an oil-tight door incorporating end-thrust bearings for the drive and work rolls. By means of this assembly the roll load is transmitted from the work rolls through the back-up rolls and the back-up bearings and saddles to the housing along the entire length of the work roll.

The first multi-roll type mill used in England employing this principle was commissioned by the Metals Division of the former Telegraph Construction & Maintenance Company Limited (Telcon), in early 1933 while the first British built Sendzimir mill was installed by them in 1953. Recently, however, the use of the latter type mills, previously restricted to producing strip about 1/1000 in. thick has been extended and Telcon Metals Limited, a member of the BICC Group have installed at their Crawley factory a Sendzimir mill for the production of foil down to 1/10,000 in. thick. Foil of such thicknesses is used for a wide variety of purposes.

Steels and heat resistant alloys may be fabricated in this way for use in such applications as diaphragms where corrosion resistance, particularly under stressed conditions, is very important. Beryllium copper foil in this gauge is used in miniature electrical applications, instrument mountings, and spacers in recorder heads. Tantalum foil can be manufactured by this type of rolling, and is used in capacitors where its thinness coupled with the characteristics of its anodised surface permits very small stable capacitors to be employed at temperatures up to 125° C. Sendzimir rolled zirconium foil is used in flash bulbs where the light emitted has a high actinic value.

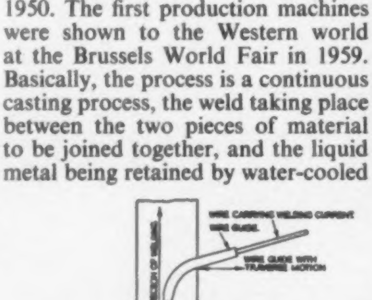
Copper foil of thicknesses of 1/10,000 in. is used in specialized printed circuit applications where compactness is essential. Copper nickel and nickel chromium alloys are used in precise resistor applications and in strain gauges of the etched foil type with high current carrying capacities, and in aircraft de-icing equipment. Ultra thin magnetic foil finds application in bobbin cores used for memory storage devices and switching cores in computer circuits.

In all of the above applications and many others the demand for thin foil of extremely high quality is rapidly increasing to meet requirements for miniaturization of components and maximization of properties demanded in so many products of modern engineering technology.

Production Electro-slag Welding

Electro-slag welding has been used by Babcock & Wilcox Limited at their Renfrew Works for the past two years. The process has been employed to fabricate thick-walled pipes, steam valves, large forgings and many other special fabrications to Class 1 standard and to comply to the appropriate British Standards. They installed a Vertomatic electro-slag welding machine supplied by Rockweld Limited, Croydon, early in 1960.

The electro-slag welding process dates from 1888 when a Russian, Count de Bernardos, invented it. The technique was not mastered until it was developed by Dr. Paton at the Paton Institute of Kiev and put into production in Russia during 1950. The first production machines were shown to the Western world at the Brussels World Fair in 1959. Basically, the process is a continuous casting process, the weld taking place between the two pieces of material to be joined together, and the liquid metal being retained by water-cooled



Vertomatic electro-slag welding machine. Left, vertical section through centre of weld

copper shoes, one placed at the back and one at the front of the weld groove.

The plate material which is edge prepared to a square edge either by planing or flame cutting, is set up

in the vertical position with a parallel gap of 1¼ in. to 1⅜ in. The copper shoes at the front and back of this parallel gap thus form a rectangular mould in which the process takes place. A starting block is fitted at the bottom of the groove, and to start the process, an arc is struck with either one, two or three continuous wires (depending on the thickness of material being welded) welding under a layer of powdered flux. The arc struck under this powdered flux is maintained until sufficient liquid slag is produced, 1¼ in. to 2 in. in depth. At this point the current is raised, the voltage lowered and the process then changes over to full electro-slag welding.

The welding heat is generated in the liquid slag by the power dissipation in the slag layer, producing a high slag temperature of the order of 1,750 to 2,000° C. There is no arc, the wire melting off as it buries itself in the slag pool. Fusion of the parent plate takes place and the molten metal which is contained by the water cooled copper shoes, solidifies as the carriage, electrodes and shoes all move vertically upwards leaving the completed weld behind them.

Lubricants for Deep Drawing Brass

A series of tests has been carried out by the Production Engineering Research Association on lubricants for the deep drawing of brass and published in PERA Report No. 60 (price 7/6 from PERA, Melton Mowbray, Leics.) The object was to determine, when deep drawing 2 in. dia cups in 0·039 in., 70/30 soft brass, the relative performance of straight mineral oils, compounded oils, extreme pressure (E.P.) oils, and water soluble compounds, using conventional (low) and elevated blankholder loads.

For applications where the use of a highly efficient drawing lubricant is desirable due to the severity of the operation, the report recommends E.P. oils or undiluted water soluble compounds when only conventional (low) blankholder loads can be applied. When elevated blankholder loads can be applied the lubricants recommended are straight mineral oils of viscosity 1000 to 1500 Redwood I seconds at 70° F, E.P. oils, or undiluted water soluble compounds.

The report remarks that for severe applications it is beneficial to increase the blankholder load beyond the value to prevent wrinkling except when using diluted water soluble compounds. A four-fold increase appears to be generally suitable, but with oils of viscosity higher than about 1000 Redwood I seconds at 70° F, or undiluted water soluble compounds, greater increases may be even more satisfactory, bearing in mind of course that any increase must be made judiciously and with regard to the viscosity of the lubricant. Lubricant additives are effective at low blankholder loads but as the load is raised the viscosity becomes more important.

Light Beam Cuts Diamond

The latest development in the work of the U.S. General Electric Company with Laser (Light Amplification by Stimulated Emission of Radiation), also known as optical Maser—Microwave Amplification by Stimulated Emission of Radiation—is the focusing of high energy light on a ¼ in. industrial diamond. In an instant (a 200 millionth of a second) a hole $\frac{1}{50}$ in. dia was drilled in the diamond.

The impact of the beam, which causes the diamond surface to vaporize, produces an explosive sound and generates temperatures in the range of 10,000° F. A blue-white jet consisting of vaporized diamond particles is seen flaring away from the point at which the invisible light ray strikes. Analysis of diamonds in which holes have been drilled reveal no structural damage.

According to Dr. J. Herbert Hollomon, head of the GE General Engineering Laboratory, the diamond experiment points the way to high speed, inexpensive techniques for machining extremely hard materials. In previous experiments holes were pierced in stainless steel, tungsten, and other hard metals difficult to machine by ordinary methods, by means of the Laser apparatus.

Diamonds can also be cut by an electron beam technique, Hollomon points out, but the Laser method promises a number of advantages, including lower cost and higher speeds. In addition, unlike the electron beam, Laser does not require operation in a vacuum.

The heart of the device which generates the diamond-cutting beam is a ruby in the form of an 8 in. long rod slightly more than ½ in. dia. A focusing lens is placed between the Laser "gun" and the object to be worked, for further concentration of the light. In the GE experiments the system was operated at room temperature, but it is known that higher energies may be achieved by cooling the ruby crystal with liquid nitrogen.

Lubricant for Hot Threaded Joints

In Russia, a graphite-copper lubricant has been used in the turbine shops of TETsVTI to prevent the seizing and scorching of threaded joints working at high temperatures. The composition of the lubricant (by weight) is: Copper powder 25%, Flake graphite 15%, Glycerine 60%.

This lubricant was used after a mass seizing up of the bolts and joints of a GT-600-1·5 gas turbine. After the turbine had been dismantled twice, 16 austenitic steel bolts of 30 mm dia became completely unusable, in spite of the fact that the bolts had been previously lubricated by means of graphite diluted with glycerine.

The seizure of the threaded joints was eliminated by the used of the graphite-copper lubricant and the time for disconnecting the flanged joints was reduced by four fifths.

As a result of this, all high-temperature flanged joints are assembled now using the graphite copper lubricant. It is reported that no seizing of the thread is found and the torque required to start the nut in unscrewing has fallen sharply.

Folding Partition

A completely new type of folding partition designed primarily for commercial and industrial use is the Marleyfold, in two versions, Standard and Acoustic, and combining economy and goods looks with simplicity of operation. Produced by The Marley Group, Sevenoaks, Kent, in sizes up to 50-ft long and 20-ft high, the Marleyfold provides wall partitioning and doors for virtually any situation. Every unit is made to measure and can be supplied on a supply-and-fix or supply only basis, individual quotations for each specification being given. Basically the partition is a metal framework of pantographic type hinges and steel rods in rust-resisting metal with a layer of leather-grained P.V.C. cloth on either side.

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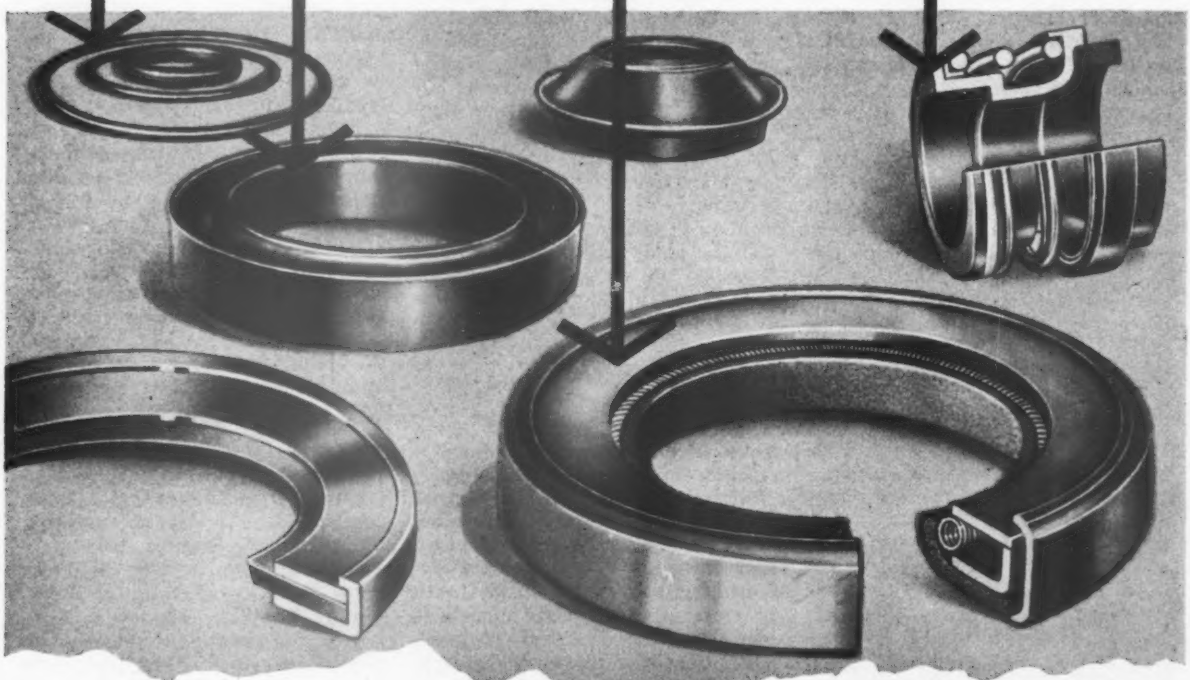

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In Brief . . . .

Notes on New Materials, Plant and Machinery

Heavy Duty Boring.—Giddings & Lewis-Fraser Limited, Arbroath, have supplied an Endomatic machine to a car manufacturer for machining layshaft gears. The machine, built on a standard bed, has two opposed boring heads and out-feeding slides.

Linkline for Lay Gears.—A linking equipment designed and made by The Hymatic Engineering Company Limited, Redditch, forms part of a B.S.A. line supplied to British Motor Corporation, Longbridge, for automatic turning, washing, and marking on a Prior machine.

Magnetic Extractor.—Magnetic units to fit into three pipeline sizes up to 4 in. dia are produced by Rapid Magnetic Limited, Birmingham 12. It has a quick release cover for removal of extracted iron particles and will withstand 200 psi line pressure.

Diesel Starter.—A new mechanical starter for diesel engines has been introduced by Simms Motor Units Limited, London. It has a flywheel which is run up to speed by hand and a variable transmission unit, engaged by clutch, which picks up the drive from 00:1 and decreases it smoothly through 1:1 to 1:00.

Unit Contactors.—Dewhurst & Partner Limited, Hounslow, have introduced two new contactors—15 amp and 25 amp 3-pole units.

Investment Castings.—The casting process used by P. I. Castings Limited, Altrincham, allows the preparation of components in complex steel alloys in economical small quantities. They use electrical melting and the centrifugal investment process and obtain precision to 0·004 in.

Conveyor Drum.—A new motorized conveyor drum incorporating a speed reduction unit is now available from Andantex Limited, Manchester 11.

Ball Race Extractor Set.—A new tool kit specially for the speedy removal of ball races from blind housings and where a running shaft may be encountered, has been introduced by J. W. Pickavant & Co. Limited, Birmingham 1.

Black & Decker Tools.—Black & Decker Limited, Harmondsworth have introduced their De Walt line of stationary equipment to the U.K. market. Immediately available are radial arm saws with their tools and attachments.

Milling Machine Vice.—Spencer Franklin Limited, London SE1, have begun production of the Spenklin milling machine vice. It has a dual hydraulic system—high speed for free movement and slow for clamping, with finger-light, automatic control.

Disc Brake Grinding.—The concept of automatic control has been carried to rather unusual lengths in the latest Scrivener 36 DPG duplex machine for simultaneously grinding both sides of disc brakes. Transfer, locking, grinding, gauging, compensation, and delivery are all performed by a controlled cycle mechanism.

Line Following Device.—The British Oxygen Company's new "Autoscan" device for their Bison cross carriage cutting machine works from pencil or ink drawings and requires no templates. Printed circuits and transistors in the amplifier control unit ensure long operating life and simplify servicing.

Pliers.—J. Stead & Co. Limited, Sheffield 2, announce a new range of Steadfast pliers with induction hardened jaws and fully insulated translucent amber sleeves. They range in size from 5 in. to 8 in. and in price (retail) from 9/- to 12/-, and are in several useful types.

Spaghetti Sleeving.—A new range of high temperature electrical sleeving is being made by Polypenco Limited, Welwyn Garden City, from the new Du Pont fluorinated ethylene propylene resin (Teflon). It is of thin-wall construction and made in 26 bore sizes.

Lighting Fittings.—A new flameproof-weatherproof industrial fitting for fluorescent tubular lamps has been introduced by Victor Products (Wallsend) Limited. It is in two sizes.

Pallets with Shelves.—Pallets incorporating the new Slydang shelving are now being produced by Metal Products (Arden) Limited, Birmingham 19.

Terminal Strip.—A new terminal strip from Kabi (Electrical & Plastics) Limited, Potters Bar, is moulded in black Vybak PVC and is flexible in both planes.

Compacting Presses.—A new series of die set presses with capacities from ½ to 100 ton is introduced by F. J. Stokes Limited, London W5, for compacting ceramic and metallic powders.

Centrifugal Casting.—The Mark III centrifugal casting machine made by N. Saunders Metal Products Limited, London SW6, will cast objects in zinc or lead alloy up to 9 in. dia., from rubber-type moulds.

Abrasive Discs.—Self-adhesive discs with abrasive surfaces, mounted on rubber holders for use with power hand tools are being produced by Engis Limited, Maidstone.

Fluorlubes.—A series of new lubricants under this name have been introduced by Omni (G.B.) Limited, London W1. They are designed to be suitable for and safe when used with oxygen equipment.

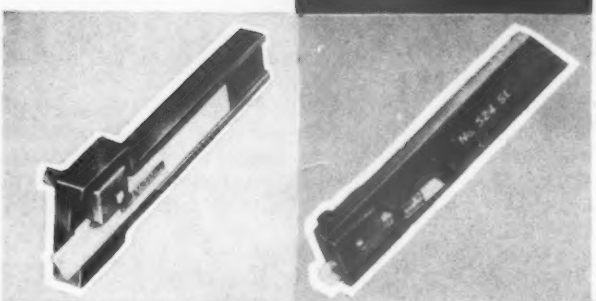
Traffic Control Barrier.—Designed for controlling traffic on factory roads, the Pullin barrier is of light tubular alloy of any length up to 16 ft. 4 in. Several barriers with automatic interlocking can be remotely controlled from one panel.

Dust Collector.—The new Dalamatic continuously-rated filter made by Dallow Lambert & Co. Limited, Leicester, has no mechanical moving parts. It is cleaned by abrupt blasts of high pressure air. Any capacity can be built up of the integrated system of units.

New High-temperature Steel.—HT9 is the designation of a new steel introduced by the Swedish Sandvik Steel Works Company. It is a 12% Cr-steel containing Ni, Mo, V and W, and is exceptionally strong at elevated temperatures. It has already been used in England for turbine parts and in Germany and Sweden for superheater tubes.

Weight Saving in Bar Mill.—Aluminium alloy spindles and chocks supplied by Alcan Industries Limited, Banbury, are proving a successful innovation in a 10 in. steel bar mill at the Sheffield works of Swift Levick & Sons Limited. A handling problem that previously created a production hold-up has been overcome.

Hypoid Base.—A new base for hypoid oils has been developed by D. A. Stuart Oil Company (G.B.) Limited, London W1. It will be used to prepare "custom tailored" oils to suit particular requirements. The company also makes a range of cutting oils.



"Eclipse" tool holders are precision made from high quality materials. Their carefully machined grooves provide rigid seating for the tool bits and their patented clamps which hold the tool by both downwards and sideways pressure ensure accurate and chatter-free turning. With "Eclipse" H3 cobalt high speed steel tool bits they provide the perfect cutting combination.

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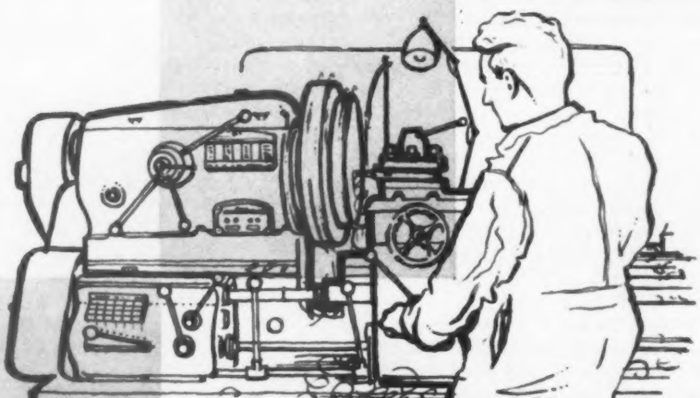

the perfect cutting combination

Made by James Neill & Co. (Sheffield) Ltd., and obtainable from all tool distributors

UT 27

Permanent Magnets and their Application. By Rollin J. Parker and Robert J. Studders. London, 1962; John Wiley & Sons Limited. 120/- net (by post 121/5). 406 pp. $5\frac{3}{4} \times 9$ in.

The primary purpose of the permanent magnet is to provide a magnetic air-gap flux. This can be done by a wound field, but the magnet needs no direct current supply and is not liable to energy failure, and it replaces a number of electrical components. Add to these considerations the fact that present day magnet alloys are very highly efficient and it is evident why the permanent magnet is becoming used so widely.

In its modern form it has gone ahead of its literature somewhat. The present book, written by two engineers of the U.S. General Electric Company, goes a long way to redress this. It explains permanent magnet relationships and theory, describes the permanent magnet materials (with charts and curves), gives the relevant design relationships, shows how to determine magnetic permeance and gives examples of the design calculation, describes a number of applications, and discusses changing the state of magnetization, permanent magnet stability, the measurement of permanent magnet properties, and concludes with a glossary of terms.

Production Technology. By D. E. Green with contributions from B. Girling, J. I. Missen, G. A. Garreau and D. E. Manning. London, 1962; Chapman & Hall Limited 50/- net (by post 51/4). 268 pp. $6 \times 9\frac{3}{4}$ in.

The new syllabuses in production engineering widen and define the limits of the subject and this book proffers a breadth of viewpoint within this modern conspectus. It commences with work study and goes on to factory layout, materials handling and factory buildings, transfer machines, analogue and digital computers, computers and the production technologist, and statistical quality control. These are important topics today; and for the student, while they are not by any means all of production engineering, they do in this collection draw together much that had to be sought from numerous sources. A useful attribute of the book is that it brings these matters conveniently within one pair of covers.

Plant Layout and Design. By James M. Moore, New York, 1962; The Macmillan Company. 75/- net (by post 77/3). 566 pp. $6 \times 9\frac{1}{4}$ in.

Before a plant can be laid out it must exist in conception. This means that the type of manufacturing process must be decided, the market explored and the selling planned, a site found and suitable buildings chosen. These matters are discussed in Part I of this book and while they are regarded as introductory to the main theme of plant layout, they are treated in considerable detail and with illuminating conciseness.

books

The subject of actual plant layout is approached as a problem in terms of experience and circumstance. It is shown how data are collected and collated and the layout developed scientifically and then the scheme evaluated. The principles and concepts of engineering economy are introduced followed by a description of the use of linear programming for making the best selection from a number of alternatives, and an explanation given of "queuing theory"—for example the determination of the optimum number of machines where parts collect to await machining. A number of salient common problems are discussed—working conditions, materials, handling, storage, services, offices, line balancing and flexibility. A collection of practice problems is included at the end of the book, where there are also appendices of tables and data relative to the subject.

Gear Load Capacity. By W. A. Tuplin. London, 1962; Sir Isaac Pitman & Sons Limited. 17/6 net. (by post 18/4). 177 pp. $4\frac{3}{4} \times 7\frac{1}{4}$ in.

"It is common for research to show that operating conditions are far more onerous than had previously been supposed, and in this case would have suggested that high speed gearing was impracticable had there not been an enormous weight of experience to prove the contrary." This is one sentence from the stimulating and forthright introduction to this book by Professor Tuplin, in which he presents working formulae by which to estimate the load capacity of spur, helical, bevel, hypoid, worm and crossed helical gears with tooth forms derived from the conventional flat-flanked teeth of a rack or a crown wheel. The treatment is essentially practical and is in four parts; the first three, on allowable load, dynamic load and natural frequencies, leading up to the fourth on the development of working formulae.

Vocabulary of Mechanics in Five Languages. English/German/French/Polish/Russian. Group 05 Theoretical Mechanics. Group 10 Strength of Materials. London, 1962: Pergamon Press Limited. £5 net. (by post £5.1.0.) 190 pp. $6\frac{1}{2} \times 9\frac{3}{4}$ in.

This volume forms part of a larger work, which in turn has its place in an extensive project of vocabularies and dictionaries which the publishers have in hand. As indicated above it gives terms in five languages, and there is an index for each, but the main entries and definitions are in English. A logical system is used for the ordering of the entries, numbered according to the recommendations of the International Organization for Standardization. The indexes of terms have a double arrangement: a strictly alphabetical order and, in addition, an alphabetical arrangement of compound terms under their qualifying word.

Theory of Elasticity. By V. V. Novozhilov. Translated from the Russian by J. K. Lusher. London, 1961; Pergamon Press Limited 80/- net. (By post 81/4). $5\frac{1}{4} \times 8\frac{1}{4}$ in.

The familiar linear theory of stress and strain has served well (and will continue to do so for many purposes) despite the clear recognition among engineers that the use of the theory has a serious limiting effect upon practical design. Now that so much work is for high duty, often employing the newer materials and alloys having rather more extensive properties, the practical approach is more often one of stress analysis rather than stress design, and the linear theory does not always help very much when what is sought is a

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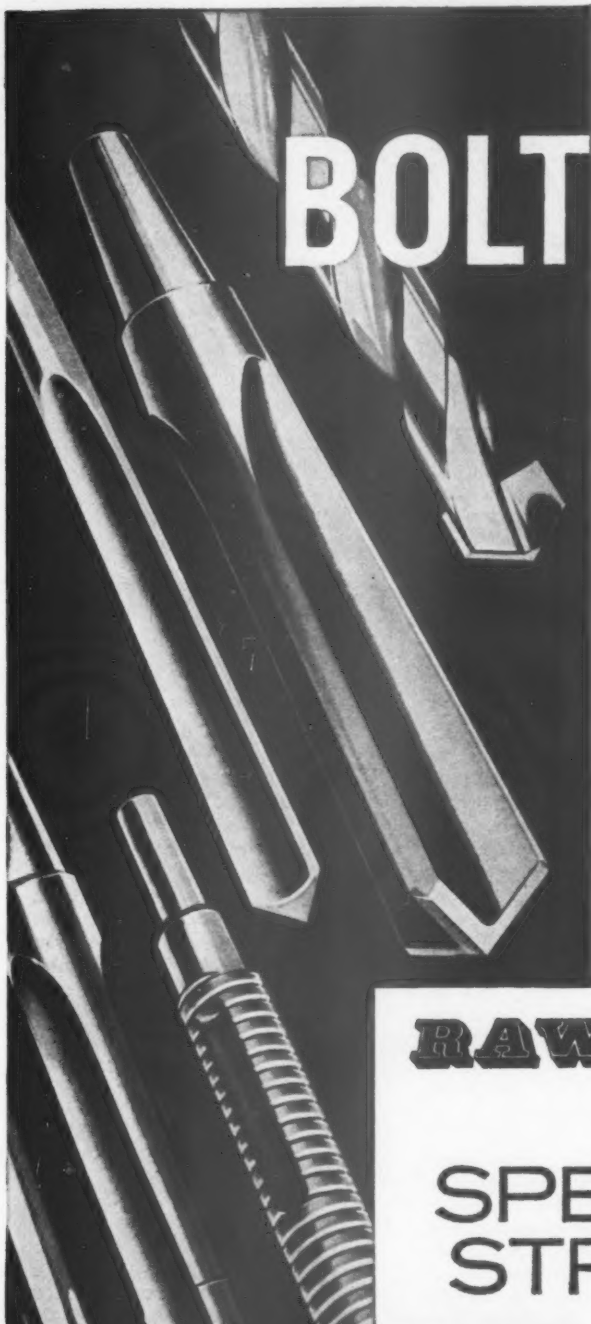

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true picture of the conditions in a component under load. The author of this important book is a leading Russian authority who has developed a general theory of elasticity of which the classical linear theory is a special case. The theory is developed from a consideration of deformation and the equilibrium of an element of volume in conjunction with strain energy principles and stress potential. To simplify certain problems the author introduces the idea of curvilinear co-ordinates in place of the usual rectangular kind. Two long chapters are devoted to the solution of the important St. Venant and plane problems.

Mechanics. By James W. Broxon. London, 1962; Peter Owen Limited. 70/- net. (By post 71/6d.) 523 pp. 6 × 9¼ in.

This is a tutorial work for a physics course such as would also be taken by engineers. It requires familiarity with calculus but provides instruction on vectors for the analytical methods used. The book is in two parts—*statics* and *kinematics and dynamics*—though the fact of the former being a special case of the latter is not disregarded in the text. The author does not keep to one system of units but uses gravitational, absolute British, c.g.s., and m.k.s. in different problems—a catholicity for which many students might be grateful.

In the first part the author deals with the statics of a particle and of a rigid body, centres of gravity and mass, simple structure, introduces non-rigid bodies, moments and products of inertia, and the bending of beams. The second part covers the kinematics of a particle, the laws of motion, force, work etc., motion of particles in uniform and simple radial fields, oscillations of a particle, rigid body dynamics, wave motion, and concludes with a brief introduction to advanced classical mechanics (calculus of variations, Hamilton's principle, principle of least action, generalized co-ordinates, holonomous mechanical systems, Lagrange's equations, Hamilton's canonical equations, and the spherical pendulum).

Worked Examples in Applied Mechanics. By J. A. Cormack, London, 1962: George G. Harrap & Co. Limited. 15/- net (by post 15/10). 222 pp. 5⅜ × 9½ in.

Knowledge is one thing and experience is another. A student gathers knowledge readily enough, but to gain experience usefully he must work alongside a mentor who will point out the right way and caution him regarding pitfalls. It greatly assists progress towards maturity if he can gain experience in the course of his studies and some present training arrangements give just that opportunity. However, the scope might be limited, and this is where Mr. Cormack comes in. Here is a full range of worked examples in plane motion, forces and moments, framed structures, centroids, second moments, radii of gyration, friction, work, energy, power, momentum, hydraulics, and strength of materials. The book is primarily for students preparing for professional examinations and some actual past papers are included in an appendix, together with answers and notes.

Computers in Structural Engineering.—The Institution of Structural Engineers has published a new report "The Use of Digital Computers in Structural Engineering", which sets out to guide those structural engineers who may for the first time be contemplating using an electronic digital computer. The types of problem most suitable for computer work, practical aspects of programming, the training of personnel, administrative procedure, programme copyright and the economics of the use of computers are examined and the report includes a number of examples and shows some of the limitations as well as the advantages of bringing electronics to structural engineering problems. An appendix sets out a glossary of terms. The report is available from the Institution, 11 Upper Belgrave Street, London S.W.1., price 11/- including postage.

Simple Corrosion Testing.—A booklet containing full instructions for a number of simple corrosion tests, mainly atmosphere, has recently been published by the British Iron and Steel Research Association. Prepared by Mr. K. A. Chandler, of the Association's Chemistry Department, on behalf of BISRA's Methods of Testing (Corrosion) Sub-Committee, this booklet—"Testing Ferrous Metals for Corrosion Resistance"—is intended to help steel users obtain a better understanding of the reliance that can be placed on tests for corrosion resistance, and enable smaller companies to carry out worthwhile tests for themselves. Copies priced 3/6d. each may be obtained from the Information Officer, BISRA, 11, Park Lane, London, W1.

Factories Act, 1961.—The United Steel Companies Limited have published the fourth edition of a pocket-sized booklet which contains, in concise form, a summary of the provisions of the Factories Acts applicable to iron and steel works. The booklet has been revised to incorporate the provisions of the new Act, which came into force in April. It has been prepared by Mr. N. H. Jones, safety consultant to United Steel and formerly a Deputy Chief Inspector of Factories. Copies may be obtained from the Welfare Department, The United Steel Companies Limited, The Mount, Broomhill, Sheffield, 10, price 3s. 6d. each.

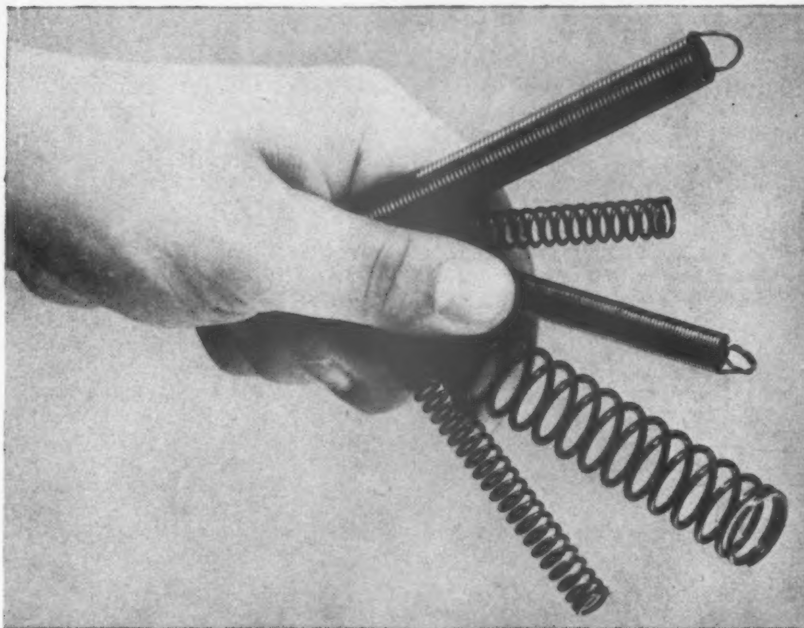
Electric Train Faults Eliminated.—All the fundamental difficulties which caused failures of multiple-unit electric trains on British Railways Scottish and Eastern Regions have now been overcome, and the faults eliminated or modifications put in hand, comments Brigadier C. A. Langley, Chief Inspecting Officer of Railways, in his final report to the Minister of Transport (H.M.S.O., 8/6d. net). A primary cause of the trouble was back-firing by mercury arc rectifiers which overstressed the transformers in the units. This type of rectifier which has worked very satisfactorily in other units, was the only proven one available when the initial orders were placed, but the rapid development of the silicon rectifier has changed the outlook. This rectifier, says the report, broke fresh ground in the field of a.c. traction, and it has been an unqualified success. With its use, short circuits from backfires will no longer arise to be a source of stress to the transformers.

New Standard

Reference tables for iron *v* constantan thermocouples (B.S. 1829:1962) Price 7/6.

This is the fourth in a series of reference tables used for converting thermocouple voltages into equivalent temperatures. It is based on the International Temperature Scale and on the Absolute Volt which, in 1948, was adopted as the standard unit in place of the International Volt. The tables themselves are based on a similar set produced by the American National Bureau of Standards.

British Standards Institution, 2 Park Street, London W1.



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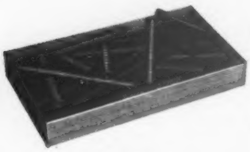
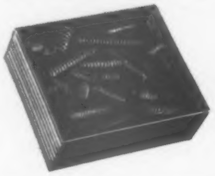


No. 1200. Three dozen Assorted Light Expansion Springs, suitable for carburettor control, etc. 15/-

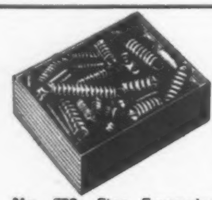


No. 757. Extra Light Compression, 1 gross Assorted, 1/8" to 7/16" diam., 1/2" to 2 1/2" long, 27 to 19 S.W.G. 18/-

No. 753. Three dozen Assorted Light Expansion 1/8" to 1/2" diam., 2" to 6" long, 22 to 18 S.W.G. 12/-

No. 760. Three dozen Assorted Light Compression Springs. 1" to 4" long 22 to 18 S.W.G., 1/4" to 1/2" diam. 7/6

No. 1217. One gross Assorted springs. 45/-



No. 758. Fine Expansion Springs. 1 gross Assorted 1/8" to 3/8" diam., 1/2" to 2" long, 27 to 20 S.W.G. 18/-

Pick the spring you want, when you want it, from our fine range of small Boxed Assortments of Experimental Springs. We can show you only a few from the range here. Send a postcard for our full list—and if ever you're stuck with a Spring problem our Research Department will be pleased to put their long experience at your disposal.

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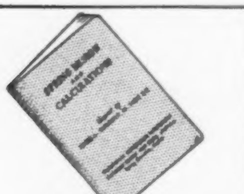
If so, the help of our Design Staff is yours for the asking.

TERRY'S *for SPRINGS*



Really interested in Springs? "Spring Design and Calculations", 11th Edition tells all—post free 12/6

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You'll need Tool Clips. Hardened and Tempered. Sizes from 1/4" to 2"

Cut Production Costs with Terry's Wire CIRCLIPS. We can supply immediately from stock—from 1/8" to 3/8".

HERBERT TERRY & SONS LTD

REDDITCH · WORCS.

(Makers of Quality Springs, Wireforms and Presswork for over 100 years)

All prices quoted subject to trade discount.

HT83

BUSINESS & PROFESSIONAL

Personal

Mr. A. Beard, technical director of Simmonds Aerocessories Limited, Treforest, Glamorganshire, has been appointed managing director of a new Firth Cleveland Group subsidiary located at Pembroke Dock, South Wales, which has been formed to produce industrial fasteners.

Mr. A. B. Mann C.B.E., B.Sc.(Eng.), M.I.C.E., M.I.Mech.E., chief mechanical and electrical engineer of the Ministry of Works, is to retire on October 26. He will be succeeded by **Mr. W. L. Wilson, O.B.E., B.Sc.(Eng.), M.I.C.E., M.I.Mech.E.,** at present an assistant chief engineer at the Ministry.

At the British Iron and Steel Research Association, the Control Engineering, Mechanical Engineering, Civil Engineering, and Energy Sections of the Plant Engineering and Energy Division, and the Instrument Section of the Physics Department are now grouped together to form a new Engineering Sciences Laboratory. **Dr. J. R. Pattison, B.Sc., Ph.D., D.I.C., A.Inst.P.,** previously head of the Energy Section, has been appointed head of the new laboratory, and **Dr. P. C. Finlayson, B.Sc., Ph.D.,** succeeds Dr. Pattison as head of the Energy Section. A newly created post is that of Materials and Standards Officer. **Mr. J. Clayton-Cave,** formerly head of the Mechanical Properties Section of BISRA's Metallurgy Division has been transferred to the Development and Information Services in this capacity. **Mr. J. Williams, Assoc. Met.,** who left BISRA two years ago, has now returned to the association on his appointment as head of the Steel User Section at the Sheffield Laboratories.

ASSOCIATED ELECTRICAL INDUSTRIES Limited announce that **Mr. C. R. Wheeler** is now managing director of the company. He has also taken over the chairmanship of the management companies from Lord Chandos.

Mr. N. J. Rose, B.Sc., personal assistant to Mr. W. S. Steel, group commercial director, AEI (Rugby) Limited, retired on May 11th 1962, after forty-eight years service with the company.

Mr. C. V. Hill, B.Eng., A.M.I.E.E., Industrial Machines Department, Rugby, AEI Motor and Control Gear Division, has retired after nearly forty-six years service. **Dr. A. Frankel, Dipl. Ing. (Zurich), M.I.Mech.E.,** has joined the AEI Turbine-Generator Division as assistant chief mechanical engineer (Development).

Mr. J. Cannell, B.Eng., A.M.I.E.E., has been appointed assistant sales manager—Programmes Co-ordination AEI Turbine-Generator Division.

Mr. J. Murray Gillespie, B.Sc. Hons., A.M.I.E.E., has been appointed Engineer-in-charge, Control Gear Department (Manchester).

H. W. WARD & CO. LIMITED, Birmingham, makers of capstan and combination turret lathes announce the appointments of **Mr. E. Williams** as managing director and **Mr. C. Needham** as deputy managing director. Mr. Williams represents H. W. Ward & Co on the board of Associated British Machine Tool Makers Limited in his capacity as deputy chairman.

RENOLD CHAINS LIMITED announces that **Mr. Edward Eagle Hempsall** has been appointed a director of the company.

Mr. Owen D. Tannett, managing director of Stanley Works (B.G.) Limited, the tool manufacturers, recently celebrated 25 years service with the company.

THE PLESSEY COMPANY LIMITED announce the appointment of **Sir Harold A Wernher Bt. G.C.V.O., T.D.,** as deputy chairman. **Mr. John A. Clark** is appointed joint managing director. **Mr. Michael Clark** and **Mr. A. E. Underwood** continue as deputy managing directors.

Mr. G. Dwane has joined the staff of Ringway Machine Tools Limited, 42, Barton Arcade, Deansgate, Manchester 3. as northern manager.

Mr. E. B. Banks, whose appointment as deputy managing director of The English Electric Company Limited was recently announced has been elected chairman of W. H. Dorman & Co. Limited. He succeeds the **Hon. George Nelson,** who now retires from the W. H. Dorman & Co. Limited board. Mr. Banks has also been appointed a director of D. Napier & Son Limited. **Mr. P. J. Daglish,** who became managing director of D. Napier & Son Limited in October 1961, has now joined the board of W. H. Dorman & Co. Limited, as a director. **Mr. T. W. Burr** has been appointed secretary and accountant to W. H. Dorman & Co. Limited, in succession to **Mr. G. S. Tucker,** who retired in March, 1962.

Renold Chains Limited announce that **Mr. L. J. Tolley,** who joined the company in 1953, has been appointed managing director. This appointment follows the retirement of **Mr. O. Bertoya** and **Mr. W. S. C. Tully, C.B.E.,** from the executive on their normal retirement date, May 1st, 1962. They remain on the board. **Mr. J. P. Halpin** has been appointed deputy managing director in addition to his executive office of Finance and Overseas Subsidiaries director.

Obituary

WE regret to record the death of **Mr. Frank Clifton,** general works manager of Ransomes and Rapier Limited, Waterside Works, Ipswich.

WE regret to record the death of **Mr. W. Weston, A.M.I.E.E., A.M.C.T.,** works superintendent, Higher Openshaw Works, Switchgear Division, Associated Electrical Industries Limited.

WE regret to record the death of **Mr. Edward William Field, O.B.E.,** managing director of H. W. Ward & Co. Limited, since 1946. He was also a director of associated British Machine Tool Makers Limited from 1954 to 1960.

WE regret to record the death of **Mr. J. K. Starnecki,** chief engineer and head of development with W. G. Pye & Co. Limited.

Addresses

THE telephone number of Du Pont Company (United Kingdom) Limited, (76 Jermyn Street, London, SW1) is now TRAfalgar 7090.

THE manufacture, sale and servicing of AEI resistance welding equipment has now been transferred to A.I. Electric Welding Machines Limited.

THE Manchester office of the Export Credits Guarantee Department has moved to Britannic Building, Fountain Street, Manchester 2, telephone number BLAckfriars 6236, telex 66756. The move is a temporary one pending a permanent move to a building now under construction in the central area.

EDGAR ALLEN & CO. LIMITED, Sheffield have established an area office at Room 24 Exchange Buildings, Newcastle-on-Tyne, Telephone No. 21891, under the direction of T. H. Miller

MATTHEWS OILS LIMITED, manufacturers of industrial and auto-motive lubricants, West Bromwich, will in future be known as Silver Knight Lubricants Limited, Trade mark and brand name "Silver Knight".

BRITISH INSULATED CALLENDER'S CABLES Limited announce that the company's Chester branch has been transferred to new and larger premises at Bumpers Lane, Sealand Road, Chester. Telephone (unchanged): Chester 23496.

THE GENERAL ELECTRIC COMPANY LIMITED, have now completed their removal from Magnet House, Kingsway, WC2 to Glen House, Stag Place, Victoria, SW1 (Board offices). Head office: Greycoat House, Greycoat Place, Victoria, SW1. Telephone: SULlivan 3411. Central marketing, export

accounts, Government and railways department, house engineers and overseas administration Kemble House, Kemble Street, Kingsway, WC2 Telephone: TEMple Bar 8000.

VOKES LIMITED, filtration engineers, have moved their London office from Victoria Street, SW1, to 21 Albert Embankment (fourth floor), SE11. Telephone No. Reliance 8355-6

STANLEY WORKS (G.B.) LIMITED, tool manufacturers, have disposed of their subsidiary company Printac Limited, to Mr. L. L. Smithies of Rochdale, Lancashire. Under its new ownership Printac will continue the manufacture and sale of Giftmark embossing machines and accessories, operating from 1, Whitehall Street, Rochdale.

THE former Burtonwood Engineering Company Limited will now be known as U.S. Industries Inc., Engineering Limited.

W. WHITFIELD LIMITED, the Dudbridge engineering firm who have been in the Stroud district for well over a hundred years, have now moved to a new works at Goodridge Avenue, Gloucester.

INDUSTRIAL PNEUMATICS LIMITED, designers and manufactures of Capsula valves for pneumatic and hydraulic applications, have moved from their Croydon works to larger premises in the Uxbridge Trading Estate, Arundel Road, Uxbridge. Industrial Pneumatics equipment is marketed in the U.K. by sole selling agents I. V. Pressure Controllers Limited, Atlas House, 683 London Road, Isleworth, Middlesex.

MOTHERWELL BRIDGE THERMAL LIMITED is the title of a new company in the Motherwell Bridge Holdings Group, which is now in operation at Uphall, Broxburn, West Lothian (Telephone Broxburn 501).

THE BRITISH WRAPPED RUBBER HOSE Manufacturers' Association has been reconstituted to include a new section representing manufacturers of wire-braided hose. It will be known henceforth as the British Hose Manufacturers' Association.

THE ALUMINIUM FEDERATION has been formed in order to take over the assets and goodwills of The Aluminium Development Association and the Aluminium Industry Council and to represent the overall interests and policy of the U.K. aluminium industry through a single body.

Contracts and Work in Progress

ASSOCIATED BRIDGE BUILDERS LIMITED, whose tender amounted to £6,057,521 have been awarded the Ministry of Transport contract for the supply and erection of the steel superstructure of the Severn Bridge.

LANSING BAGNALL LIMITED. American order worth $1½m. for industrial trucks.

F. W. BRACKETT & CO. LIMITED, Colchester. —Contract to supply four automatic double entry CUP type circulating water screens and ancillary equipment, for installation at Tilbury 'B' Power station.

ASSOCIATED ELECTRICAL INDUSTRIES Limited. *Motor and Control Gear Division.* Order valued at £21,000 for electric motors for Stone and Webster Engineering Limited. *Heavy Plant Division.*—Contract worth £142,000 for the supply of equipment to the Bell Bay, Tasmania, works of the Aluminium Production Corporation Limited of Australia. AEI Marine Equipment for New Zealand. Main and auxiliary machinery for two deisel electric fire fighting tugs to be built in connection with the new refinery project at Marsden Point, Whangarei, New Zealand. Another 120 MW turbine generator has been ordered by the North of Scotland Hydro-Electric Board, the second for the new Carolina Port thermal power station, new Dundee, and the order includes the associated feedwater heating plant. Davy-AEI Limited, Knutsford, Cheshire. Order from Colvilles Limited for automatic gauge control equipment for a new 6-stand 68 in. hot strip finishing mill at Ravenscraig.

WILD BARFIELD LIMITED Watford, Herts.— Order from Worthington Simpson Limited, for the supply of furnaces for their heat-treatment department at their Newark factory.

Electrode salt bath capable of heat-treating material up to a temperature of 1350° C. ordered by the Sturtevant Engineering Company Limited, of London which is responsible for ordering and supplying plant for hardware factory in Rumania.

GENERAL ELECTRIC COMPANY LIMITED.— Order for six G.E.C. Pennsylvania reversible impactors, worth £50,000, four for Italy and two for the United Kindgom.

TARMAC CIVIL ENGINEERING LIMITED.— Contract awarded by Ministry of Works for the construction at Buxton of a reinforced concrete gallery, nearly ¼ mile long, for research into causes and control of explosions in Coal mines.

Business Developments

Company Acquisitions

B. ELLIOTT & CO. LIMITED—machine tool manufacturers and distributors, have completed the purchase of Modern Machine Tools Limited of Coventry.

EDGAR ALLEN & CO. LIMITED, Sheffield steelmakers, tool manufacturers and engineers, have formed a new company, Industrial Heat Exchangers Limited, Imperial Steel Works, Sheffield, as a wholly-owned subsidiary.

Trading Agreements

ASSOCIATED BRIDGE BUILDERS LIMITED is a new company formed recently by three major British bridge-building firms—Sir William Arrol and Company Limited, the Cleveland Bridge and Engineering Company Limited, and Dorman Long (Bridge and Engineering) Limited.

ARRANGEMENTS have been made recently for Electro-Physical Instruments Limited to join the Hilger & Watts group of companies and the necessary formalities are now being completed.

BY agreement between Twiflex Couplings Limited (Sheepbridge Group) and Findusco S. A. Switzerland, Twiflex will make and sell the German Vulkan (rubber tyre) type couplings.

Agents and Distributors

TELEHOIST LIMITED, Cheltenham, have acquired the U.K. selling rights of the complete range of positive displacement gear type pumps, fluid motors and valves manufactured by the oil hydraulics division of the Webster Electric Company of Racine, Wisconsin, U.S.A.

Film News

"*Listen Please*" is the title of one of a series of three supervisory training films now available from The Rank Film Library. It emphasises the importance of listening in the supervisory job. 16 mm. copies of "*Listen Please*" are available from The Rank Film Library, 1 Aintree Road, Perivale, Greenford, Middlesex. Hire charge £1— purchase price £20.

Transportable Servicing Unit

TECALEMIT (ENGINEERING) LIMITED, subsidiary of Tecalemit Limited have designed a new transportable servicing unit available for mounting on an LWB Land Rover or complete with trailer. The price of the unit for mounting on the Land Rover is £564 10s. 0d. and complete with two wheeled trailer, £790 0.s 0d.

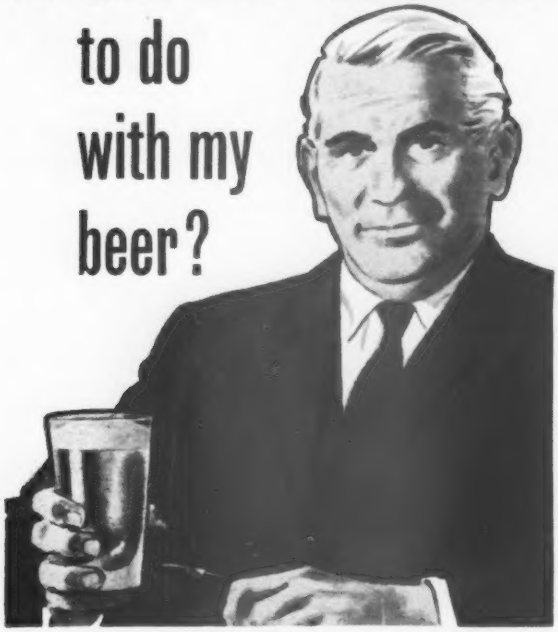
David Brown Expansion

As a part of a plan to double the output of certain types of gear units and increase production of other general gearing products, David Brown Industries Limited is to enlarge its Sunderland factory to accommodate the whole of the Radicon worm gear unit manufacture.

Instrument Apprenticeship

AN illustrated brochure prepared for the information and guidance of young men contemplating a career in the instrument industry has been published by the Cambridge Instrument Company Limited.

...and what has BLACK-MOLY to do with my beer?



BLACK-MOLY

The sheer pins on a Cask Washing Machine in a modern brewery were lasting only two days. These breakages were eliminated by the use of Black-Moly M.M. Grease. A Cask Washing Machine is only one small piece of equipment requiring lubrication in a brewery but wherever it is required there is a Black-Moly Oil or Grease to keep things going.

Cheers! Here's to Black-Moly!

This is only one of the many, many problems outside the range of normal oils and greases, which Black-Moly is capable of overcoming. In fact, more than 50 special grades of Black-Moly are available to the industry. Post the coupon below; if we do not have a lubricant to meet your requirements we shall be pleased to advise against specific enquiries.

Molybdenum Disulphide, the base for Black-Moly, is a rare mineral which when suspended in oil, in a micronated mineral form, is the finest lubricant known.

To : JOHN MILLER & SON LTD · BRIGHOUSE · YORKSHIRE

WITHOUT OBLIGATION send me further details of BLACK-MOLY Molybdenised Lubricants. Ask your representative to arrange an appointment.✱

Name ______________________

Company ______________________

Address ______________________

______________________ Telephone ______

Position in Firm ______________________

M.W.7.62 *✱Delete as required.*

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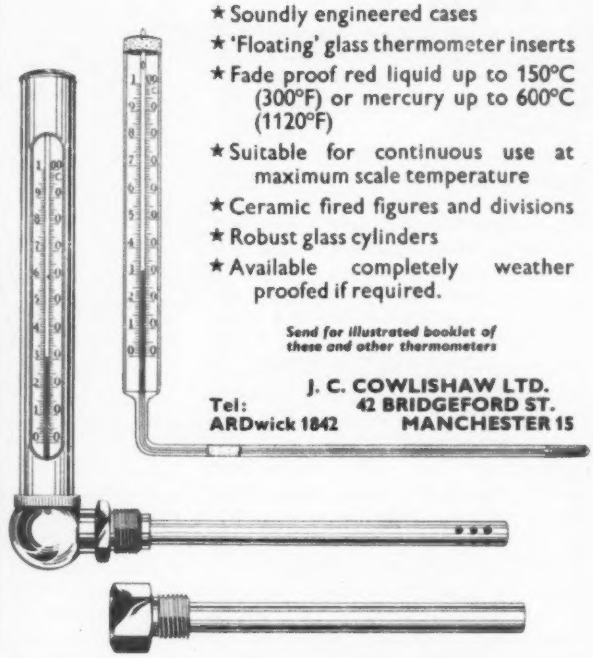
JOHN W. MILLER & SON LTD

Brighouse Yorkshire England Tel: Brighouse 1047 (3 lines)

METAL CASED INDUSTRIAL THERMOMETERS

(Mercury or Spirit in Glass)

TO SPECIFICATION



- ★ Soundly engineered cases
- ★ 'Floating' glass thermometer inserts
- ★ Fade proof red liquid up to 150°C (300°F) or mercury up to 600°C (1120°F)
- ★ Suitable for continuous use at maximum scale temperature
- ★ Ceramic fired figures and divisions
- ★ Robust glass cylinders
- ★ Available completely weather proofed if required.

Send for illustrated booklet of these and other thermometers

J. C. COWLISHAW LTD.
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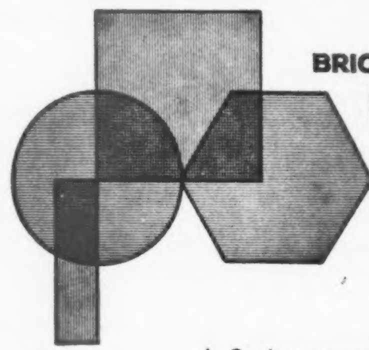
MANCHESTER 15

Tel: ARDwick 1842



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ALLOY
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PRECISION GROUND

- ★ Quality controlled throughout all stages of manufacture.
- ★ Large stocks covering a comprehensive range ensure first class service.
- ★ Our name is your guarantee of satisfaction.

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STEEL PARTS LIMITED

SPARTAN WORKS · WEST BROMWICH · STAFFS.

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Battery Chargers

A new 28-page catalogue from Hackbridge & Hewittic Electric Company Limited, Walton-on-Thames, gives details of battery charging equipment for battery production, power and sub stations, emergency lighting plants, garages and battery service stations, and electric vehicles.

Precision Tubing

The properties etc. of the precision drawn stainless and alloy steel tubing made by Fine Tubes Limited, King Charles Road, Surbiton, Surrey, are given in a new brochure. The company's new Plymouth mill will come into operation late this year.

Aluminium for Industry

A brochure from High Duty Alloys Limited, Slough, Bucks, illustrates the company's plants and typical products of the various divisions—casting, forging, rolling, extrusion, and research.

Information System

A new illustrated 16-page booklet describing the Bailey-750 information system for process and power plants is available from Bailey Meter Company, 1050 Ivanhoe Road, Cleveland 10, Ohio, U.S.A.

Heating Coils

A range of standard heating coils for hot water and steam, and duct booster coils, are described in Bulletin B-1918 from American Standard, Detroit 32, Michigan, U.S.A.

Tape Deck

The latest Emidata instrumentation tape deck is described in a new leaflet from EMI Electronics Limited, Hayes, Middx.

Electric Vehicles

A booklet setting out the advantages of the electric vehicle and truck to industry has been issued by The Electric Vehicle Association of Great Britain Limited, 2 Savoy Hill, London WC2.

Electronic Instruments

A new edition of their abridged catalogue of electronic instruments is available from Cawkell Research & Electronics Limited, Western Avenue, Acton, London W3.

Fibre and Plastics

The Anglo-American Vulcanized Fibre Company Limited, Bath Street, London EC1, have issued a new 60-page catalogue of technical data on fibre and plastics in a great variety of forms and sections.

Tailored Tooling

A new brochure from Kennametal (Great Britain) Limited, 82-84 Coleshill Street, Birmingham 4, gives full details of the new Kendex adjustable units for the "Tailored Tooling" system for metal cutting machine tools.

Glass Tinting

A folder from Sun-X (Great Britain) Limited, 37 Mincing Lane, London EC3, describes a liquid plastic window coating which reduces unwanted heat, light and glare.

Tape Reader

An attachment for the automatic reading of messages and other data code-punched in Standard 5-track paper tape is described in an illustated leaflet from Creed & Co. Limited, Croydon.

Machine Tools

An illustrated folder from Times Machinery Company Limited, Payle Road, Colnbrook, Slough, illustrates the company's premises and indicates the range of machine tools marketed.

Trade Literature

Readers interested in any of the catalogues reviewed here can obtain copies by mentioning* MECHANICAL WORLD *when writing to the firms concerned.

Machining Bakelite Laminated

Bakelite Limited, 12-18 Grosvenor Gardens, London SW1, have prepared a 32-page technical booklet on the machining of Bakelite Laminated. All processes are dealt with and useful tables of data are included.

Plastics Components

The Ray Engineering Company Limited, Southmead, Bristol, make a wide range of machine knobs, handles, handwheels etc. in plastics. The various Rencol patterns are illustrated and sizes given in a new 24-page catalogue.

Thread Rolling

The Waterbury Farrel vibratory feed flat die thread rolling machines which deal automatically with headless components are described in a leaflet from George H. Alexander Machinery Limited, 105, Tyburn Road, Birmingham 24.

Stamford Alternators

Arthur Lyon & Co. (Engineers) Limited, Park Works, Stamford, Lincs., send a new catalogue of their range of generating sets, from house lighting plant to industrial alternators up to 300 kVA.

Fan Equipment

A folder from London Fan & Motor Company Limited, 331 Sandycombe Road, Richmond, Surrey, describes three propeller fan units: one for humidifying, one for man cooling (both portable), and one for roof fitting.

Cables and Cable Laying

The Equipment Division of Submarine Cables Limited, Greenwich, London SE 10, a company owned jointly by AEI and BICC, has issued two catalogues of Telcon cableship equipment, hydrographic and oceanographic equipment, marine auxiliaries, and heavy haulage and mining equipment.

Pyroglass and Dixlink

These two names designate products of R. & J. Dick Limited, Greenhead Works, Glasgow SE. The first is a PTFE-coated glass fabric endless belts, gaskets, tapes etc., and the second a popular driving V-belt which can be adjusted to any required length. New catalogues are available on both.

Draftless Forgings

High Duty Alloys Limited, Slough, have a technique for producing light alloy forgings without draft. A number of examples are illustrated in a new booklet.

Induction Heating

Garringtons Limited, Bromsgrove, Worcs., have issued a series of new brochures describing their induction heating units for press feeding, shaft hardening, stress relieving, billet heating, bearing fitting etc.

Hot Galvanizing for Structural Steel

A booklet of this title from the Hot Dip Galvanizers Association, 34 Berkeley Square, London W1, gives much technical data for the user on the process, costs, maintenance etc.

Beryllium Copper

A new version of their publication 1073, on Mallory 73 beryllium copper, is available from Johnson, Matthey & Co. Limited, 73-83 Hatton Garden, London EC1. It gives particulars of properties, availability, heat treatment, fabrication and tables of tolerances, weights etc.

Electrical Equipment

A number of new catalogues are available from English Electric Company Limited, Stafford. They deal with high voltage excitrons (RS/135), squirrel cage motors (DM/328), Unistat variable speed drive (CG/119), Ward-Leonard variable-speed drive (CG/118), the KDP10 data processing system in banking (DP/109), for billing (DP/110) and insurance (DP/111), butterfly valves (HE/145), and control equipment for winders and haulages (MN/119).

Gas Carburizing and Nitriding

The Gas Council (1 Grosvenor Place, London SW1) in co-operation with manufacturers and users of gas carburizing and gas carbo-nitriding plant, has produced a brochure illustrating applications of town gas to process. It is available from Area Industrial Gas offices or direct from the Council.

Mechanical Handling Equipment.

The new catalogue of the Mechanical Handling Engineers' Association, 94/98 Petty France, London SW1, is in three languages and illustrates a variety of machinery for conveying and elevating, both fixed and portable, drag scraping, aerial conveying, pneumatic handling, wagon tippling and marshalling, and various chute work.

Dependable in far away places

because of its simple construction, automatic action, overload protection plus a first rate after sales service.

'We wish to record our sincere appreciation of the excellent service you extended to our plant at Warrington on Wednesday night.
We find such service and help practically unique these days'

READY MIXED CONCRETE
(LIVERPOOL) LIMITED.

BROADBENT
CENTRIFUGAL CLUTCHES

THOMAS BROADBENT & SONS LTD
CENTRAL IRONWORKS
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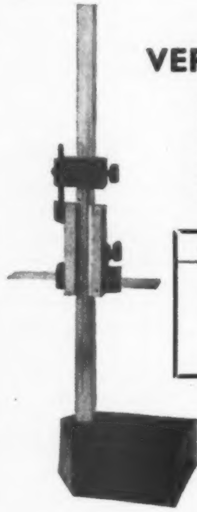
VERNIER CALIPER GAUGES

For direct reading of inside, outside and depth measurement. With quick-action cam-lock.

Graduated in 1/10 mm. + 1/128" (V.22)
or „ 1/1000" + 1/128" (V.24)

Model No.	Length	Bright	Stainless
		£ s d	£ s d
V.22	5¼"	2 12 6	3 6 0
V.24	6"	2 19 6	3 9 6



VERNIER HEIGHT GAUGES

With fine adjustment, to read 1/1000"
Beam graduated in 1/20"
Vernier graduated in 50 divisions,
Square Scriber.
Available up to 60" reading

Model No.	Reading	Bright
		£ s d
H.230	12"	11 0 0
H.232	20"	22 0 0
H.235	36"	38 15 0

We are also importers of:
DEPTH GAUGES, PROTRACTORS, PRECISION TRAMMELS of various design.

PRECISION COMBINED DRILLS AND COUNTERSINKS

NEW DESIGNS

(*a*) With reinforced shoulder between sections, producing pilot shank and countersink, ensuring a precise guide, resulting in a gradual drilling operation and decreases breakage.

(*b*) With spiral flutes to form a bore with curved flanks, to ensure the drilling of an accurate hole, therefore correcting alignment of Lathe centres.

Made of S.H.S.S.				60°
Drill point diameter	from	0·5 mm.	=	0·0197"
	to	6·3 mm.	=	0·250"
Body diameter	from	3·15 mm.	=	1/8"
	to	20 mm.	=	13/16"

MICRO PRECISION DRILLS

Made of Super High Speed Steel, hardened and ground from the solid, with reinforced standardized shanks. Sizes from 0·002" to 0·0787" diameter.

PRECISION TWEEZERS

Available in 20 different Models. In Bright Polished, Nickel Plated and Stainless Steel.

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ERIC H. BERNFELD, LTD. LONDON, E.8

282 KINGSLAND RD. 'Phone: CLIssold 4837

Crook (Co. Durham). Whessoe Limited, Darlington, are to erect a unit at Crook for the making of glass reinforced plastic tanks.

Darlington. Road Services (Forth), Limited. Plans are being prepared by Chippindale and Edmondson, 37a Tubwell Row, Darlington, for the erection of a vehicle depot and offices at McMullen Road.

Hepworth and Sons Limited. Plans are in hand for erection of shops, and extensions to hotel in Prebend Row. The architects are Ardin, Brookes and Partners, 6 Cavendish Place, Cavendish Square, London, W.1.

Gateshead. Northern General Transport Company. Work has started extending and modernizing the Bensham depot. The builders are Bewley and Scott Limited, Dunston-on-Tyne.

J. Aitchison and Company (Tyres) Limited, North Road, Berwick, propose three-storey depot at Church Street, Gateshead.

Houghton-le-Spring. North-Eastern Electricity Board. Plans have been approved for the erection of offices, garage etc., at Penshaw. The architects are L. J. Couves and Partners, Grainger Chambers, Hood Street, Newcastle upon Tyne.

Jarrow-on-Tyne. Charles Lennig and Company, chemical manufacturers. The contract for the erection of offices and workshops has been let to Purdie, Lumsden and Company, Oxford Street, Newcastle upon Tyne.

Middlesbrough. Greco Bros. Additions are proposed to biscuit factory. The architect is C. H. Johnson, 38 Albert Road, Middlesbrough.

Newcastle upon Tyne. Initial Services Limited. The contract for the erection of a laundry depot at Fisher Street, has been let to John Laing Construction Limited, New Bridge Street.

North Shields. Gibson Ready-mixed Concrete Limited, Haddricks Mill Road, Gosforth, propose concrete batching plant and offices at Albert Edward Dock.

Seaham. Joseph Elgey Limited. Plans are being prepared by Charles Elgey, 2 North Bailey, Durham City for joinery works.

Stockton-on-Tees. Harker and Sons (Engineers) Limited, Stockton. Plans for new offices in Church Road have been approved.

Charles Tennet (Contractors) Limited, Church Road, Stockton, propose store buildings, offices, etc., at Portrack Lane, Stockton.

Washington (Co. Durham). Cook, Son and Company Limited. Additions are proposed to Washington Steelworks. The work will be carried out by direct labour.

J. H. Harrison Limited, Park Road, Gateshead, are planning the erection of offices at their Springwell Quarry, Washington.

Binstead, Isle of Wight. A. N. Clark (Engineers) Limited, Phipps Road, Merton, London SW, are to build a new factory.

Birmingham. A new factory is to be erected in Summer Lane for W. W. Greener Limited, St. Mary's Row.

Bollington. Kay Bros. (Plastics) Limited, Hollins Lane, Marple, are to build a new works on the Waterhouse Mill site.

Coventry. Plans have been approved for the erection of a new factory at Torrington Avenue for Leigis & Son Limited.

Dagenham. The factory of Glendale Cabinet Company Limited, in Fowler Road, Hainault, is to be extended.

Extensions are to be made to the factory in Rainham Road South for Ever-Ready Company (G.B.) Limited.

Ascott Precision Tool Company Limited are to extend their factory at Roebuck Road, Hainault industrial estate.

Doncaster. Roofseal Limited are to build new premises at Low Road.

Dundee. Lintafoam Industries Limited, are to erect a new factory. The architects are Wylie, Shanks & Wylie, 12 Clairmont Gardens, Glasgow.

Frimley. The factory of Johnson's Wax Limited, is to be extended. The architects are Clifford Gee & Gale, 5 Eccleston Street, London SW1.

Glasgow. Associated Metal Works (Glasgow) Limited, 30 St. Andrews Square, Glasgow, C1, are to extend their works. The architects are Wilson, Hamilton & Wilson, 5 Woodside Terrace, Glasgow C3.

New Factories

Greenock. A new factory is to be built for Inchgreen Engineering Company Limited, Inchgreen.

Eastbourne. Stainless Steel Pumps Limited, are considering the erection of a new factory.

High Wycombe. Thurlow & Janes, 86 Easton Street, are the architects for extensions to the factory of G. D. Searle & Co. Limited.

Ilford. J. Kendricks & Sons, are to erect a new factory at Roden Street.

Leeds. The works of S. Denison & Son Limited, Moor Road, is to be extended.

Letchworth. E.M.M.E. Limited are to make extensions to their factory.

London. Bedford Steer End & Co. Limited. Extensions are to be made to the factory at Long Lane, SE1. The architect is C. W. Lowe, St. Thomas Street, London Bridge, SE1.

Ivo Engineering & Construction Company Limited, Wood Lane W12, are to build a new factory at Scrubs Lane, Hammersmith. The architects are Hughesdon & Hinds, 4 Abingdon Road, Kensington W8.

Louth. Peter Dixon & Son, Spring Grove Mills, Oughtibridge, are to build a new factory.

Macclesfield. H. E. Mowbray Limited, Lower Heys Mill, are to extend their factory at Hurdsfield industrial Estate.

Maidenhead. Eric G. Hives & Sons, 46 Queens Road, Reading, are the architects for extensions to the factory of Fairey Air Surveys Limited.

Manchester. City and Northern Properties Limited have plans for industrial development at Byrom and Cavalry Street, Cheetham.

Morecambe. Plans have been approved for extensions to the factory of Glass Fibre Laminates Limited, White Lund.

Ollerton, Notts. Approval has been received for the erection of a smokeless fuel plant at Newark Road for National Carbonizing Company Limited, Woodhouse Road, Mansfield.

Oxford. Stevco Limited, St. Thomas Street, are to erect a new workshop at Lamarsh Road.

J. H. Grant Limited, 64 Princess Street, are to build a new works at Horspath Road.

Redditch. A new factory is to be built in Arrow Road for Linford Engineering Company Limited, 93 Baker Street, Birmingham 11.

Rochdale. Tedson Thornley & Co. Limited, are to make extensions to their Robert Street Works.

Romford. Higgins & Thomerson, 90 Romford Road, London E15, are the architects for extensions to the factory of R. & I. Connell Limited, Ashton Road, Harold Hill.

Rotherham. Steel, Peech & Tozer Limited are to erect new works in Deadman's Hole Lane.

A workshop and offices is to be built on the Eastwood trading estate for Northern Erection Company Limited.

Sheringham. A new factory is to be erected for Kingsland Engineering Company Limited, The architects are Fielden & Mawson, 71a The Chase, Norwich.

Shoreham. Beagle Aircraft Company Limited, are to erect a new factory at Shoreham Airport.

Shrewsbury. Renault Machine Tools (U.K.) Limited are to make alterations to their works at Harlescott.

Southend-on-Sea. A new factory is to be built at Eastwood industrial estate for E. P. Allam & Co. Limited, 132 Sloane Street, London SW1.

Wakefield. Henson & Carver, Leeds have submitted plans for the erection of a new works at Craven Street and Vicarage Street.

Watford. A new furniture factory is to be erected for S. Hill & Co. Limited, St. Albans Road, Watford. The architect is E. Goldfinger, 69 Piccadilly, London W1.

Wigan. Extensions are to be made to the Pagefield Works for Walmsleys (Wigan) Limited.

Woolwich. A new factory is to be built at Northern Way for Gale Baiss & Co. Limited. Plans are by J. R. Eve & Son, 1 Deane Yard, London SW1.

Wrexham. The works of the Brymbo Steel Company Limited are to be extended.

Arbroath. Giddings & Lewis-Fraser Limited are to erect a £7000 sand drying plant as part of their engineering works.

Ardrossan. The Ardrossan Dockyard Limited have been sold to Mr. Archibald D. Kelly who carries on a sugar machinery and engineering factory at Greenock. The yard will continue to handle the repair side and will also develop metal working fabrication.

Clydebank. Singer Manufacturing Co. Limited, employing 12,000 workers will completely modernize their plant at a cost of £4 million. They will demolish the present factory and replace it with a 110,000 sq ft single floor unit.

Gateshead. Detroit Beet Company, 211 Shields Road, Newcastle-on-Tyne. The architects for a proposed beet boiling and packing factory at South Shore Road are M. and H. Gatoff, 26 Mosley Street, Newcastle-on-Tyne.

Glasgow. Frederick Braby & Co. Limited, structural engineering, Springburn, are redeveloping their Springburn Plant. Work from Auto Diesels Limited, Uxbridge is being transferred to the Springburn plant.

Ponteland (Northumberland). Moto Plastics Limited, Ponteland. The architects for factory and offices are P. L. Browne, Son and Harding, Pearl Buildings, Northumberland Street, Newcastle-on-Tyne.

West Calder. The Halmo Engineering (Scotland) Limited, organisation will locate a plant at Burngrange to undertake a wide range of metal finishing, welding and fabrication work.

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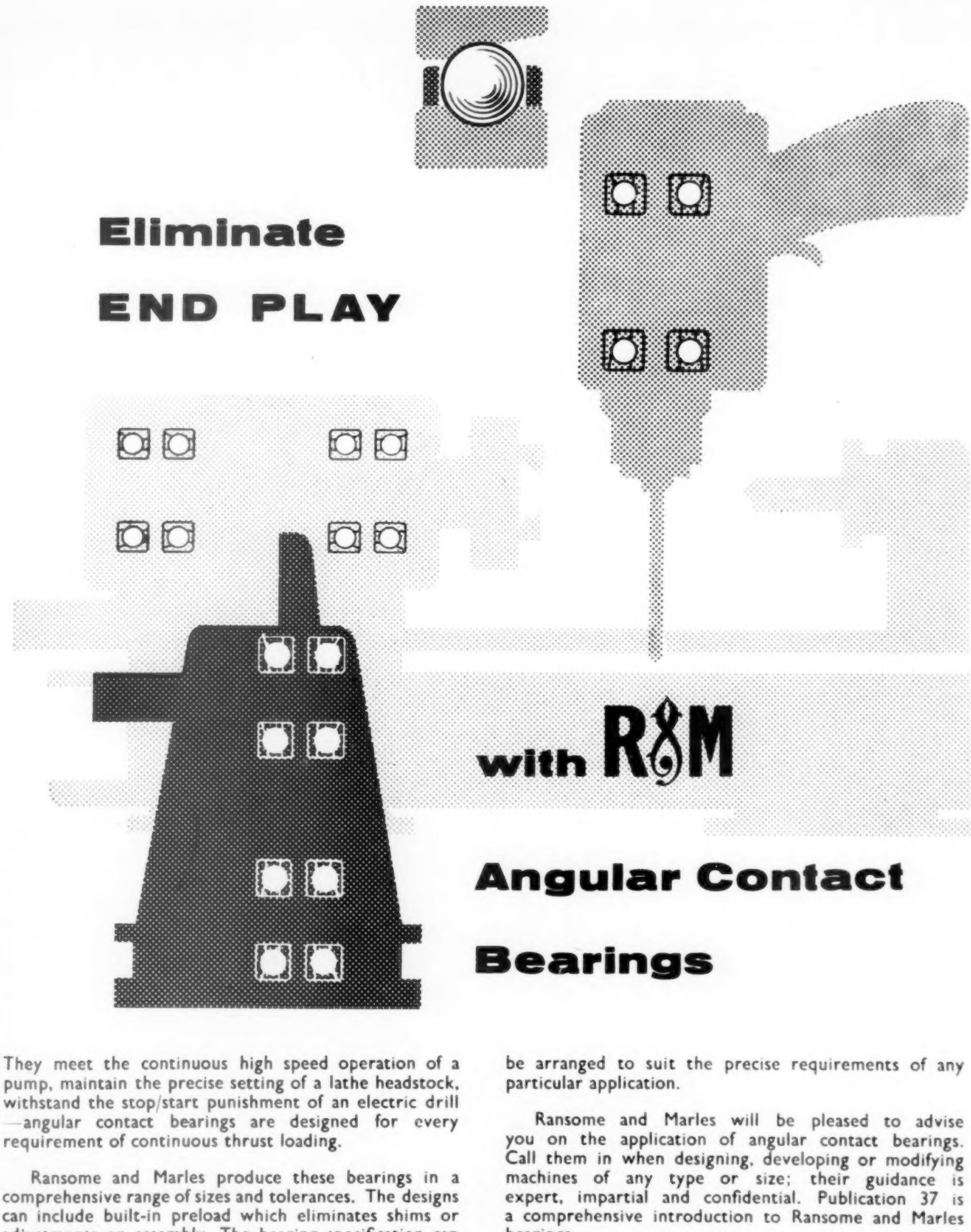

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